



DONALD M. BAKER

D.M.B. MAY 11 1923









# REPORT

OF THE

## Department of Public Works

OF THE

STATE OF CALIFORNIA

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### FIRST BIENNIAL REPORT

November 1, 1922

AUSTIN B. FLETCHER, Director of Public Works



CALIFORNIA STATE PRINTING OFFICE  
SACRAMENTO, 1922

REPORT

OF THE

Department of Public Works

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STATE OF CALIFORNIA

FIRST BIENNIAL REPORT

November 1, 1925

JOSEPH A. FLETCHER, Governor of Public Works



PRINTED BY THE STATE OF CALIFORNIA  
1925



REPORT OF THE DIRECTOR OF PUBLIC WORKS,  
DEPARTMENT OF PUBLIC WORKS, STATE OF CALIFORNIA,  
FOR THE BIENNIAL PERIOD ENDING DECEMBER 31, 1921.  
LETTER OF TRANSMITTAL.

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SACRAMENTO, November 1, 1922.

*Honorable WILLIAM D. STEPHENS,  
Governor, State of California.*

SIR: I have the honor to submit herewith the First Biennial Report  
of the Department of Public Works of the State of California.

Respectfully,

A. B. FLETCHER,  
*Director of Public Works.*

LETTER OF TRANSMITTAL

Sacramento, November 1, 1922

Honorable William L. Stevenson,  
Governor, State of California

Sir: I have the honor to submit herewith the First Biennial Report  
of the Department of Public Works of the State of California.

Respectfully,

A. B. Henderson,  
Director of Public Works



## REPORT OF THE DIRECTOR OF PUBLIC WORKS.

The Department of Public Works was one of the State departments organized by the 1921 legislature and it began its operations on July 30, 1921, when the changed law took effect.

This department was formed by a merger of the previously existing Department of Engineering (including the California Highway Commission, a subdivision thereof), the State Water Commission, the State Land Settlement Board and the State Carey Act Commission. (For reorganization, see chapters 602 and 607, Statutes of California, 1921.)

The Director of Public Works is also ex officio State Highway Engineer.

The work of the department by law is segregated into five divisions, namely:

1. Division of Highways (California Highway Commission).
2. Division of Engineering and Irrigation.
3. Division of Water Rights.
4. Division of Land Settlement.
5. Division of Architecture.

This report relates to a period of great activity. All of the several divisions have engaged in a greater volume of work than ever heretofore and the period has been one of great accomplishment.

The report is made up of six parts or chapters of which the Director's report is Part I. Each division has its separate report as follows:

Part II. Division of Highways (California Highway Commission).

Part III. Division of Engineering and Irrigation.

Part IV. Division of Water Rights.

Part V. Division of Land Settlement.

Part VI. Division of Architecture.

The division reports go much into detail; each report is complete in itself and it is accordingly not necessary to repeat in this part of the report more than some of the most important features.

### CONSOLIDATED FINANCIAL STATEMENT.

During the period July 29, 1921, to July 1, 1922, the total expenditures of the department were \$20,029,657.47, or an average disbursement of more than \$1,800,000 per month. By divisions the monthly expenditures averaged as follows:

Highways .....	\$1,522,462 00
Engineering and Irrigation .....	21,633 00
Water Rights .....	10,316 00
Land Settlement .....	89,266 00
Architecture .....	177,199 00

The accompanying tabulation is a consolidation of the financial statements of the several divisions for the period above stated. The details of this statement will be found in the several division reports.

**STATE OF CALIFORNIA.**  
**DEPARTMENT OF PUBLIC WORKS.**

**FINANCIAL STATEMENT FOR PERIOD JULY 29, 1921, TO JUNE 30, 1922.**

	Balance Available July 29, 1921	Other Receipts	Total Expenditures	Balance on Hand July 1, 1922
<b>CALIFORNIA HIGHWAY COMMISSION</b>				
State Highway Funds	\$ 5,309,420.34	\$14,165,000.00	\$11,292,207.91	\$ 7,066,027.30*
Motor Vehicle Fund	303,299.08	3,018,192.35	3,546,892.31	285,686.89
Special Appropriations	167,604.37	107,500.00	28,159.72	247,444.16
Federal Aid	275,981.20	1,573,500.94	1,843,482.14	
Contributions		34,343.85	33,343.85	1,000.00
<b>TOTAL</b>	<b>\$ 5,449,706.83</b>	<b>\$18,898,537.15</b>	<b>\$ 16,747,085.93</b>	<b>\$ 7,601,158.05</b>
<b>DIVISION OF ENGINEERING &amp; IRRIGATION</b>				
General Support Appropriations	49,510.77		26,083.89	23,426.88
Co-operation with U.S. Gov't & Other Agencies	76,405.85		51,401.25	25,004.60
Rectifying & Improving River Channels	225,885.39		70,155.47	155,729.92
Investigation of State Waters	200,000.00		89,716.72	110,283.28
<b>TOTAL</b>	<b>\$ 531,802.01</b>		<b>\$ 237,957.34</b>	<b>\$ 293,834.67</b>
<b>DIVISION OF WATER RIGHTS</b>				
Departmental Income	884.37	16,577.22	15,958.41*	503.18
General Support Appropriations	176,224.61	512.98	71,270.54	105,067.05
Survey of Water Resources	47,670.00	1,000.00	20,036.03	28,634.97
Cash revolving fund	50,000.00		416.07	49,583.93
Co-operative Contributive Funds	441.52	5,000.00	4,403.38	1,032.14
<b>TOTAL</b>	<b>\$ 275,220.50</b>	<b>\$ 23,090.20</b>	<b>\$ 113,489.43</b>	<b>\$ 184,821.27</b>
<b>DIVISION OF LAND SETTLEMENT</b>				
Land Settlement Fund - Berkeley Office & Durham	44,879.11	68,529.69	89,968.84	23,419.96
Land Settlement Fund, Delhi	601,387.38	93,372.16	691,936.97	2,822.57
<b>TOTAL</b>	<b>\$ 646,266.49</b>	<b>\$ 161,901.85</b>	<b>\$ 981,925.81</b>	<b>\$ 26,242.53</b>
<b>DIVISION OF ARCHITECTURE</b>				
State Agricultural Society				
Agricultural Park	40,055.26		22,807.41	17,247.85
The Adjutant General's Office				
Armories	900.00			900.00
Department of Institutions				
Homes	589,962.90		92,007.17	497,955.73
Hospitals	1,842,315.24		427,052.34	1,415,262.90
Schools	552,180.22		147,682.75	404,497.47
Department of Education				
Schools	837,599.14		479,727.02	357,872.12
State Board of Prison Directors				
State Prisons	175,758.72		129,707.69	46,051.03
Veterans Home of California	128,496.32		52,719.55	75,776.77
Capitol Building	8,593.85		12.57	8,581.28
San Francisco State Building	728,338.94		390,580.54	337,758.40
Sacramento State Building	2,864,537.85		29,544.74	2,834,993.11
State Printing Office	175,000.00		32,550.86	142,449.14
State Nursery at Davis	22,114.67		20,977.18	1,137.49
Secretary of State - Office Vault	587.30		55.00	532.30
Fish & Game Commission	26,705.94		26,507.45	198.49
Murphy Monument	16.77		10.75	6.02
Kontrey Custom House	185.85			185.85
Fort Ross Repairs	1,053.28		697.00	356.28
Division L.P. Del Solano Sonoma	11,123.31		79.62	11,043.69
Panama California Exposition Building	10,000.00			10,000.00
Redwood Park	34,000.00		18,550.41	15,449.59
Building Alterations, Dept. of Agriculture	3,195.00		3,195.00	
General Support Appropriations	170,092.31		74,743.23	95,349.08
Compensation Benefits	300.00		272.68	27.32
<b>TOTAL</b>	<b>\$ 8,223,017.87</b>		<b>\$ 1,949,188.96</b>	<b>\$ 6,273,828.91</b>
<b>GRAND TOTAL</b>	<b>\$16,326,013.70</b>	<b>\$19,083,529.20</b>	<b>\$20,029,557.47</b>	<b>\$14,379,885.43</b>

\* Balance of Highway Bonds Authorized but Unsold - \$16,000,000.00.

\* Funds in Treasury - but apportionment not yet allocated to California Highway Commission.

\* Turned into State General Fund.

NOTE: For supporting detail of financial condition of each Division see report for that Division.



## CENTRAL OFFICE.

The acts creating the department make no specific provisions for the setting up of a central office but with the approval of the Governor and the assistance of the State Board of Control this difficulty was surmounted.

The following excerpts from a memorandum prepared for the Governor show some of the reorganization questions which required attention and solution:

"\* \* \* The department, by law, will have the following divisions:

Division of Highways.

Division of Engineering and Irrigation.

Division of Architecture.

Division of Land Settlement.

Division of Water Rights.

"Some of the appointments of the officers of the department are to be made by the Governor and some by the Director, subject to the Governor's approval.

The Governor appoints:

The Director.

Three members of the California Highway Commission.

Five members of the Advisory Board to the Division of Land Settlement.

"As concerns the Advisory Board to the Division of Land Settlement, the law is somewhat ambiguous and I presume it will be safer to appoint or reappoint in this case. The present board consists of Messrs. Mead, Cogswell, Fleishhacker, Flint and Wangenheim.

"It appears to be the duty of the Director to appoint all chiefs of divisions and all of the subordinate assistants and employees in the divisions, other than the Division of Highways.

"The California Highway Commission (Division of Highways), with the Governor's approval, apparently appoints all of its employees except the State Highway Engineer.

"Undoubtedly the Director will appoint the following division chiefs:

Wilbur F. McClure, Chief of Engineering and Irrigation.

George B. McDougall, Chief of Architecture.

Elwood Mead, Chief of Land Settlement.

Charles H. Lee, Chief of Water Rights.

The salaries of these officers are fixed by law and the Director should require of each of them an official bond in the sum of \$15,000.

"For the present, and until a careful study may be made, it is obvious that the assistants and employees of the California Highway Commission, the State Department of Engineering (including the architectural employees), the Land Settlement Board, and the State Water Commission should be reappointed to serve under the appropriate divisions. The Director, however, should recommend from time to time such changes in the personnel of the divisions composing the department, where the statute gives him the appointing power, as will promote economy and improved service.

"*Accounting:* The Director will undoubtedly wish to consolidate all of the accounting of the department by making use of the Highway Commission facilities and place it under the charge of the chief accountant of the Commission. The system of accounts of the Commission has stood the test for nearly ten years and is in competent hands.

"*Purchasing:* The Highway Commission for nearly ten years has bought millions of dollars of materials through its own purchasing department. The Director will doubtless wish to make use of the Commission's purchasing agent in securing the materials for the entire department.

"Heretofore the State Engineering Department (Engineering and Architectural Divisions) has secured all of its materials and supplies through the State Purchasing Agent attached to the office of the State Board of Control. The State Purchasing Agent has lost the man who was familiar with the purchase of engineering and construction supplies and the vacancy has not been filled. The Highway Commission's purchasing agent buys the same line of materials and is familiar with and skilled in the work. This consolidation is advisable.

"*Testing Laboratory:* Closely allied with the Purchasing Agent is the testing of the materials. The State Purchasing Agent now has a chemical labora-

tory located in the Forum building, occupying costly space, and the Highway Commission has always operated a laboratory for mechanical testing and is now about to construct a much larger building with a chemical department added. There seems to be no good reason why the Highway Commission's new laboratory should not do all of the work for both the State Purchasing Agent and the Department of Public Works. Messrs. Daniels and Jarvis approve this scheme and I do not see how the new member can fail to acquiesce. \* \* \*

Under the general scheme of operation outlined in the foregoing memorandum, which the Governor approved, a little central office was organized, with the addition of but one new assistant, Miss Myrtle V. Murray, who was made secretary of the new department.

The cost of the central office is met in the following manner:

The operating expense was estimated to be \$6,000 per annum, made up as follows:

*Salaries:*

Full time of Myrtle V. Murray, secretary-----	\$2,400
Part time of R. C. Miles, auditor-----	1,000
Part time of M. E. Sparks, assistant to the Highway Engineer-----	300

*Incidental expense:*

Office rent, telephone, telegraph, postage, stationery, printing, etc.-----	2,300
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This expense is prorated to the various divisions on the following basis:

Division of Highways-----	35 per cent
Division of Architecture-----	25 per cent
Division of Engineering and Irrigation-----	15 per cent
Division of Land Settlement-----	15 per cent
Division of Water Rights-----	10 per cent

The following monthly charges are made against the respective divisions for their proportion of the expense of operating the accounting and purchasing departments:

	Accounting department	Purchasing department
Division of Architecture-----	\$866 70	\$242 75
Division of Engineering and Irrigation---	231 30	98 25
Division of Water Rights-----	81 50	27 50
Division of Land Settlement-----	81 50	42 88

**DIVISION OF HIGHWAYS.**

The report of the California Highway Commission (Part II) goes into much detail concerning the particular problems of the State highway work.

The main commercial traffic lanes during the past ten years have been paved, or will be before the end of the present year, and in addition, many of the less important roads provided for in the bond issues have been improved.

Owing to the great increase in traffic during the decade the most important work facing the Commission appears to be the widening and thickening of the pavement on the main lines of the system. This problem should receive first consideration, even to the extent of possibly postponing the raising of additional funds for completing the State highway system.

At the same time, however, there is much new highway work of great importance to the people of the State which should not be postponed indefinitely. The improvement of the primary roads connecting California with its sister states on the north, and particularly on the east, is of urgent importance. The coast and valley lines to Oregon on the north and the connections with Nevada and Arizona on the east are all incomplete, and funds available at the present time will not permit of completing any one of these roads.

The State highway bond measures now provide for eight interstate roads from California eastward. These are:

- Route 28. Redding-Alturas lateral.
- Route 29. Red Bluff-Susanville lateral.
- Route 37. Auburn-Verdi.
- Route 11. Placerville-State line.
- Route 63. Big Pine-Oasis.
- Route 58. Barstow-Needles.
- Route 64. Mecca-Blythe.
- Route 27. El Centro-Yuma.

The "Federal aid seven per cent system" includes the following routes in the same direction:

- Route 37. Auburn-Verdi.
- Route 11. Placerville-State line.
- Route 63. Big Pine-Oasis.
- Route 58. Barstow-Needles.
- Route —. Near Goff-State line on route to Las Vegas, Nevada.
- Route 27. El Centro-Yuma.

Of these six routes which have been approved by the Secretary of Agriculture of the United States as parts of the 7% Federal Highway System, Route 37, Auburn to Verdi, and Route 27, El Centro to Yuma, are of the class (three per cent system), the improvement of which the federal government expects to have expedited.

It seems to be obvious that all eight of these interstate roads can not be improved within any short space of time and it seems to be equally obvious that good business judgment should indicate that the action of the Commission must be concentrated upon the most important. One road from the east entering the northern part of the State and another the southern part, each highly improved, would be of very great service to travelers desiring to come by highway to California. Now, there is no such entrance, north or south, which measures up to the standard which such travelers have a right to expect of California.

Other highway projects, greatly needed, are the construction of certain bridges to enable vehicles to reach San Francisco from central and northern California without having to cross one or more ferries. It is doubtful if a proposed bridge across San Francisco Bay, whether located at Dumbarton, Ravenswood Point, or at Coyote Point, useful as such a bridge would be, will answer the problem satisfactorily for any considerable period. It can not be gainsaid that San Francisco needs more outlets by highway to the south, and these must be built, but the greater problem will not be settled until a bridge is built to connect the



highways of Contra Costa County with those of Solano County, or perhaps Sacramento County, a comparatively low cost structure, together with the construction of another and much more costly bridge crossing the northerly end of the bay to connect the cities of Oakland, Alameda and Berkeley with the great city of San Francisco.

The problem, a vital one from a transportation standpoint, if from no other, should be given early and earnest consideration. The bridges should be "free bridges" not subject to the exaction of tolls. The cost will be very great but the necessity is great also and the project should be approached in a broad minded attitude.

The future development of all northern California depends much upon the right solution of this problem.

In its report the California Highway Commission says:

"Experience has demonstrated that the mere passage of a regulatory law is useless unless machinery is set up for its enforcement. The Highway Commission recommends the establishment of an adequate force of state motor police to enforce traffic laws on state highways. It is the opinion of the Commission that such officers should operate under the direction of the Highway Commission for the reason that the body charged with the responsibility of maintaining highways should be vested also with the power to adequately protect them."

The Director of Public Works, while he approves heartily the sentiment above expressed, is of the opinion that a still better plan would be to have the whole Motor Vehicle Division made a division of the Department of Public Works, this appearing to be a more logical assignment than at present. Now the Motor Vehicle Division is a subdivision of the State Department of Finance.

#### ENGINEERING AND IRRIGATION.

The Division of Engineering and Irrigation occupies a most important position in the future agricultural development of California. Through it the regulatory powers of the State, essential to organized irrigation development, are exerted as are also the State's influence and prestige in its participation in the meritorious efforts of the associated groups promoting such development.

In the period of its existence, first as the State Engineer's office, recently as a division of the larger department, it has contributed greatly to California's phenomenal progress. The report of the division (Part III) by Mr. W. F. McClure, chief of division and State Engineer, includes with much detail what has been accomplished by the old State Department of Engineering and by its successor, the Division of Engineering and Irrigation.

California, when it was the foremost State in value of annual gold output, mined over eighty millions of this yellow metal during its banner year, but in value this achievement was less than a fifth of its present agricultural products.

The State has attained during the past generation this preeminent position in value of agricultural products through the increased productivity of its farm lands, accomplished by irrigation and by watering only a quarter of the lands needing the additional moisture for maximum production.

The irrigation of additional lands in the remaining area will demand of the State a greater participation than heretofore for the solution of the many complicated and vexing problems attendant upon the construction and administration of the works of irrigation.

The important place which the division is bound to occupy in the future demands that special attention be given to the proposed legislation needed to effect certain changes in organization. These changes, outlined in detail in the division report (Part III), contemplate a consolidation of the activities of the Division of Engineering and Irrigation, the California State Bond Commission and the Executive Directors of the Water Storage Act, a plan desirable both to secure more economical administration and to afford a more satisfactory organization upon which the rapidly expanding functions of the division may build. This new legislation has the approval of Mr. W. F. McClure, State Engineer, and the members of the State Bond Commission.

The great increase in activity in these important functions during the past two years, clearly indicated in this report, measures the acceleration with which the irrigation of the State's arid lands is advancing.

The division during the past biennium acted upon the organization of thirty-three irrigation districts having a combined area of 1,803,221 acres and investigations are now in progress as to the feasibility of three water storage districts.

Irrigation district projects financed by more than \$60,000,000 worth of bonds have been investigated and reported upon and the division is now exercising general supervision of the expenditure of this vast sum. It has passed on plans for the construction of dams having estimated costs amounting to nearly \$8,000,000, and these dams are now being constructed under inspection by the office. Work of this kind requiring the most careful inspection is rapidly increasing in volume.

Since the organization of the Department of Public Works this division has undertaken under the direct supervision of Mr. Paul Bailey, deputy chief of division, the stupendous task of investigating the water resources of the entire State, an appropriation of \$200,000 having been made for this purpose by the 1921 legislature. The entire investigation and report will be completed within sixteen months from the time of beginning, an accomplishment of a task which many thought would be impossible at the outset. This report will present a comprehensive statement of the water resources in all parts of the State; the irrigation requirements of all agricultural lands; the maximum storage and use of all waters; and plans for development, with costs.

The office has also completed during the past biennium detailed studies and special reports on the water resources and their utilization in Kern County, in Tulare County and in San Jacinto Valley.

The division cooperates with the State Reclamation Board in engineering studies of flood control in Sacramento and San Joaquin valleys; in stream gaging and topographic mapping with the United States Geological Survey; in irrigation investigations with the United States Department of Agriculture; in the investigation of irrigation projects with the United States Reclamation Service, and in restraining debris on the Yuba River with the California Debris Commission.

The work of the division in these respects for the past biennium is fully described in the division report (Part III).

#### DIVISION OF WATER RIGHTS.

This division does the work of the former State Water Commission created by referendum vote on November 3, 1914.

Major H. A. Kluegel, chief of the division, in his report (Part IV), says:

“The true purpose of the Water Commission Act is to provide the legal machinery by which new vested rights to the use of water may be acquired, while at the same time, rights which have already vested by use may be protected in their use of water. All new rights by appropriation must be acquired through the procedure required by the act and hence, through the supervision exercised by the Division of Water Rights, a complete record, valuable to both the state and the applicant, of the progress from the time of filing until use of the water is made is available, and when question arises there is little difficulty in finding from the record exactly what has been done.”

Much excellent work in recording and protecting the rights to the use of water was accomplished under the former Commission and the work has continued in greater volume and done equally well under the Division of Water Rights which succeeded it.

Mr. C. H. Lee was the first appointed chief of the division, he having been also the chairman and executive member of the old Water Commission. Because of an unreconcilable difference of opinion between Mr. Lee and the Director of Public Works as to certain administrative matters, chief of which was the question of the location of the office of the division—whether it should remain at San Francisco or be moved to Sacramento, to be in close touch there with the several other divisions of the department—Mr. Lee was displaced in January, 1922, by Major Kluegel. Mr. Lee's conduct of his division was able and conscientious and there was nothing in the separation to reflect discredit on his professional qualifications or on his conduct of his office.

With the knowledge attained by a somewhat intimate acquaintance with the activities of this division, the Director concludes that to save overlapping of functions the law should be changed so as to merge the Division of Water Rights with the Division of Engineering and Irrigation. This may not be done without legislative authority.

The duties of the Division of Water Rights under the law are:

1. To issue permits and licenses for the appropriation of unappropriated waters in the streams of the State.
2. To revoke permits and licenses for non-fulfillment of conditions of issuance of permits and licenses.
3. To adjudicate rights by appropriation on streams of the State.
4. To supervise the diversion of waters from streams of the State through appointment of water masters.
5. To act as referee in suits in superior courts involving rights to water or its use.
6. To prescribe time for perfection of rights by appropriation initiated prior to the passage of the Water Commission Act.
7. To act on applications for change in point of diversion of rights by appropriation.



8. To determine conditions for joint occupancy of works or enlargement of works necessary for the maximum use of waters of a stream.
9. To investigate stream systems and determine the amounts of unappropriated waters therein for the purposes of the Water Commission Act.
10. To investigate the feasibility of projects for putting unused waters to beneficial use for the purposes of the Water Commission Act.

To perform these duties it is necessary for the Division of Water Rights to have a staff of engineers, well qualified in the science of hydraulics. The elements of water law and knowledge of procedure before the office which these engineers need in their work is acquired by contact with the work. The clerks of the staff are required to handle forms, which is a matter of training and instruction of competent persons. The education and experience necessary to be employed by the Division of Water Rights is practically identical with that of the employees of the Division of Engineering and Irrigation.

The Division of Engineering and Irrigation in performing its duties under the California Irrigation District Act, the California Bond Certification Act and the Water Storage Act, is required to estimate the amount of unappropriated water in streams; to estimate the validity of water rights; to determine the amount of available water in the streams of the State; and to determine the feasibility of projects for putting unused waters to a beneficial use, in order to pass on the organization of these districts and the issuance of their bonds. While these investigations of the Division of Engineering and Irrigation are made for purposes differing from those of the Division of Water Rights, they are alike in character, but unlike principally in the amount of detail with which the subjects are investigated. The engineers of the one office equally are qualified to perform work in the other office after a brief contact with the procedure of that office.

Both offices conduct special investigations and assemble information on the water resources of the State and their development for beneficial purposes. The work of the two offices is identical in this respect and its pursuit requires much exchange of information and data to prevent duplication of effort and work.

The functions in which the two offices differ lie in the use to which the basic information is put. In the Division of Water Rights it is used to consider action by the office relative to the right to use the water, while in the Division of Engineering and Irrigation it is used to consider action by the office relative to the organization of projects to use the water and the issuance of securities to finance their construction work.

Perhaps the work of the Division of Water Rights requires a more general circulation of its employees over the State than the work of the Division of Engineering and Irrigation because of the many applications concerning diversions by individuals on small streams. However, the great impetus to development of irrigation by district organization of the last few years is causing the Division of Engineering and Irrigation to keep in close contact with development on practically every large stream in the State.

The advantages to the State to be gained by combining these two divisions into one organization are:

1. Placing in one filing system like information on similar subjects and avoiding the necessity of assembling much information in duplicate.
2. Avoiding duplication of effort and work in the investigation of stream flow, unappropriated waters, status of water rights, and feasibility of projects.
3. Removing confusion in the minds of the public concerning the jurisdiction of the two offices and simplifying the procedure and reducing the time and expense on the part of the public in gaining State approval in its various phases on the development of the water resources.
4. Furthering the concentration of authority in matters concerning the development of the water resources and assisting in effecting a State policy in the development of its water resources.
5. Reducing administrative expenses somewhat and making it possible to materially reduce traveling expenses by avoiding duplication of trips of assistant engineers into the same territory.
6. Making one larger organization to afford greater elasticity in assigning work to assistants and in the use of equipment with consequent possibilities of economy in functioning.

#### LAND SETTLEMENT.

The report (Part V) of this division, of which Dr. Elwood Mead is chief, shows how California has combined service to settlers with land selling. It shows how in a period of the hardest times ever known to farmers settlers have been able to meet their payments on farms, continue their improvements and help build up a wholesome and successful rural life.

Dr. Mead says:

"Both settlements are solvent enterprises. The land in the first settlement at Durham was sold for more than enough to pay for the land and meet all development expenses. After the State has been paid the principal and interest of its advance there will remain a surplus profit of \$140,000. The other State settlement at Delhi is still being developed, but if the farms are sold at prices now fixed there will be a considerable surplus over all State expenses. The increase in population and taxable wealth which is coming to the State from this policy has, therefore, placed no burden on California taxpayers. Three hundred and fifty-six farmers have found homes in the two settlements, of whom more than a hundred are ex-service men.

What the State is doing to help ex-service men of little capital to learn how to farm and to pay for their farms marks this as a unique and valuable feature of this enterprise which was not thought of at first. Another feature is the large number of homes for farm laborers who had no capital. Some of these men who started with nothing have been able to save enough to buy ten-acre farms."

The report is a clear statement of the relation of State-aided land settlement to the prompt and successful development of irrigation districts and shows that there is the same need for financing settlers that there has been for providing the millions of dollars with which reservoirs and main canals have been built.

The fact that there are a million acres of land in existing irrigation districts awaiting settlement makes this one of the most important social and economical problems of the State.

#### DIVISION OF ARCHITECTURE.

No other agency of the State has so many varied activities as the Division of Architecture. In the report of the division (Part VI), George B. McDougall, chief of division and state architect, says:

“The duties of the Division of Architecture at the present time may be summed up as follows:

To make plans and specifications for all new buildings of a value in excess of \$1,000 at the various State institutions; to let contracts for and superintend their erection or in case satisfactory contracts can not be made, to construct the buildings by day labor; to care for all alterations and repairs to existing buildings, on the same basis where the amount involved is in excess of \$1,000; to design, and install all heating, lighting, ventilating, refrigerating, water supply, mechanical and electrical plants of every nature—whether changes, extensions, or original; survey grounds, lay out walks, drives and roads; provide water supply, sewer and drainage systems, requiring the design and construction of dams, reservoirs, pipe-lines, wells, pumping plants, ditches, sewage treatment and disposal plants and drains.

The State of California has at the present time twenty-eight major institutions, at which the division functions as outlined in the preceding paragraph. In addition to these, there were twenty-seven places at which either construction of some kind was supervised, or expert assistance given during the past two years.

These fifty-five points of activity are scattered from one end of the State to the other; this element of distances to overcome, being one of the most difficult of the conditions surrounding the activities of the bureau.”

The division is well organized and ably managed and no vital changes in legislation seem to be needed at this time except as follows:

1. There is available at present for the joint use of the Division of Engineering and Irrigation and the Division of Architecture a cash revolving fund of \$30,000, of which \$7,000 has been allotted to the Division of Engineering and Irrigation and \$23,000 to the Division of Architecture, this allotment having been made at the time of the organization of the Department of Public Works. This amount is insufficient, due to the volume of day labor work being handled by the division, and a cash revolving fund of \$60,000 should be made available for the exclusive use of the Division of Architecture; provision for the Division of Engineering and Irrigation to be made separately.

2. At all the State institutions there have been installed steam plants of varying capacities to suit the conditions and also costly electrical



and mechanical equipment. The design and installation of these plants and appliances is determined upon and made by the Department of Public Works, Division of Architecture.

When the completed plant has been turned over to the institution, connection of the Division of Architecture with it ceases. All of these plants are operated independently, each by the authorities of the particular institution. This results in varying degrees of efficiency in up-keep and operation; in some cases efficiency in these respects is high and in others low, with resulting excessive costs to the State.

An act should be passed giving the Department of Public Works, Division of Architecture, control over the operation of these plants to such a degree as to permit of periodical examinations and checks being made by a representative of the division with a view to securing and maintaining efficient operation of each plant; and where such operation is not being obtained, to permit of the division giving and having followed out such instructions as to repairs and control of the action of the institution engineer, including his dismissal from the service if that should be required, as the division may recommend.

The expense involved would be the salary and traveling expenses of the engineer making the periodical examinations and reports.

The savings in fuel and maintenance costs would be many times the expense.

The State building at San Francisco is nearing completion and the Sacramento State buildings have been started as has also the State printing plant at Sacramento.

The State Architect, in the report of his division, calls attention to the fact that for each of these important buildings additional appropriations will be required to complete them in accordance with the plans.

In each of the several parts of the report is exhibited an "organization chart" showing the relationship existing between the officers and employees of each division and also their relationship to the central office.

Appended hereto is a complete roster of the officers and employees of the department as called for by the act creating the department.

The Director here expresses his appreciation of the able, conscientious and loyal support given to him by the several chiefs of divisions and their assistants and employees.

He is particularly grateful to Governor William D. Stephens, whose kindly advice and wise counsel have been given often.

A. B. FLETCHER,  
*Director of Public Works.*

# APPENDIX A.

## LIST OF OFFICERS AND EMPLOYEES IN SERVICE OF DEPARTMENT OF PUBLIC WORKS.

In accordance with chapter 602, article II, section 354, Statutes of 1921, the following statement is submitted showing the number and classes of officers and employees in the Department of Public Works and compensation paid, as of June 30, 1922:

A. B. Fletcher, Director and State Highway Engineer.....	\$10,000
Myrtle V. Murray, Secretary.....	2,400
Newell D. Darlington, Chairman, California Highway Commission.....	3,600
Chas. A. Whitmore, Member, California Highway Commission.....	3,600
Geo. C. Mansfield, Member, California Highway Commission.....	3,600
Wilbur F. McClure, Chief, Division of Engineering and Irrigation, and State Engineer.....	5,000
H. A. Kluegel, Chief, Division of Water Rights.....	5,000
Elwood Mead, Chief, Division of Land Settlement.....	5,000
Geo. B. McDougall, Chief Division of Architecture.....	4,800

## CALIFORNIA HIGHWAY COMMISSION.

Name	Position	Division	Salary
Abbott, C. C.	Rodman	II	\$85 00-B
Abbott, C. E.	Instrumentman	II	140 00-B
Achtert, A.	Assistant resident engineer	IV	200 00
Adams, Harry	Axman	I	65 00-B
Adams, John C.	Chainman	IV	75 00-B
Adams, L. F.	Axman	I	65 00-B
Adams, Walter P.	Draftsman	IV	150 00
Adkins, L. W.	Levelman	III	110 00-B
Ager, Arthur F.	Draftsman	II	180 00
Agnew, J. E.	Draftsman	IV	150 00
Ahern, T. P.	Instrumentman	IV	140 00-B
Ainley, O. N.	Resident engineer	VII	235 00
Alderson, W. H.	Draftsman	Hdq.	225 00
Aldrich, Winthrop	Levelman	I	125 00-B
Alexander, P. T.	Draftsman	Hdq.	175 00
Alldritt, Mable	Stenographer	I	125 00
Allen, H. Fay	Draftsman	VII	235 00
Allison, H. Harold	Assistant resident engineer	III	150 00
Alstrom, J. C.	Assistant resident engineer	I	150 00-B
Anderson, A. L.	Chief clerk	VI	175 00
Anderson, R. J.	Clerk	Hdq.	125 00
Andrews, Zula	Assistant accountant	Hdq.	135 00
Apsley, Edgar	Chainman	I	75 00-B
Arata, Winfield H.	Draftsman	V	140 00
Ashcom, Gilbert	Axman	II	70 00-B
Avery, H. T.	Office engineer	V	235 00
Babb, E. N.	Clerk	II	200 00
Bachtold, H. J.	Draftsman	II	175 00
Backe, Chas. W.	Assistant engineer	IV	250 00
Badger, R. S.	Assistant division engineer	VI	275 00
Baer, Sylvan	Computer	I	125 00
Bailey, Edwin P.	Chainman	III	70 00-B
Bair, H. J.	Resident engineer	VI	230 00
Baker, A. A.	Instrumentman	III	125 00-B
Baker, Bernice	Clerk	Hdq.	75 00
Baker, Francis R.	Resident engineer	III	235 00
Baker, Harry E.	Assistant draftsman	VI	125 00
Baker, J. W.	Assistant, resident engineer	III	150 00
Baker, McKinley	Chainman	VI	80 00-B
Balfour, J. A.	Rodman	I	90 00-B
Ball, James	Cook	IV	100 00-B
Balsz, H. F.	Instrumentman	III	125 00-B
Banbrock, W. E.	Rodman	III	90 00-B
Bane, Murray	Chainman	VI	65 00-B
Barnes, Charlotte	Switchboard operator	Hdq.	75 00
Barney, W. E.	Draftsman	V	125 00

NOTE.—Letter "B" indicates that board is furnished in addition to salary.

Name	Position	Division	Salary
Baroni, Jos. N.	Levelman	II	95 00-B
Barrett, Fay N.	Stenographer	Hdq.	125 00
Barrett, James C.	Assistant resident engineer	VII	175 00
Barry, Richard	Instrumentman	I	140 00-B
Bartlett, Wallis H.	Axman	II	75 00-B
Bartlett, Willis H.	Rodman	II	95 00-B
Baruch, Emil	Clerk	VII	140 00
Bascom, Wm. S.	Draftsman	VII	190 00
Bass, Alfred M.	Assistant draftsman	III	100 00
Bass, Clara M.	Stenographer	Hdq.	110 00
Bassett, Edwin J.	Resident engineer	II	235 00
Bastein, Geo. A.	Draftsman	IV	125 00
Batham, Lloyd A.	Draftsman	IV	235 00
Batelle, Geo. L.	Draftsman	III	200 00
Bauders, Meldon L.	Rodman	II	100 00-B
Bauer, Caroline L.	Stenographer	IV	120 00
Baymiller, Rex R.	Rodman	II	90 00-B
Beardslee, Mrs. Irma	Typist	III	90 00
Beaughan, Mrs. N. E.	Assistant draftsman	II	120 00
Becker, Elsie M.	Stenographer	VI	100 00
Beckmann, C. G.	Draftsman	IV	70 hr.
Bedford, T. A.	Division engineer	II	400 00
Begeer, B. W.	Clerk	Hdq.	110 00
Belford, Herbert E.	Draftsman	VI	165 00
Belknap, Fred R.	Instrumentman	VII	135 00-B
Belknap, S. I.	Draftsman	I	125 00-B
Bell, L. C.	Chairman	VII	85 00-B
Bellenot, M. F.	Axman	II	70 00-B
Bennett, Albert N.	Rodman	IV	90 00-B
Bennett, B. S.	Superintendent	V	250 00
Benson, Orrell G.	Draftsman	VI	75 hr.
Bergman, R. A.	Resident engineer	I	225 00
Bernegg, Theresa O.	Stenographer	III	100 00
Berry, Beulah	Stenographer	Hdq.	125 00
Bertenshaw, James W.	Chairman	IV	80 00-B
Bertken, Leslie F.	Assistant resident engineer	VI	100 00-B
Bertken, W. K.	Assistant resident engineer	VI	115 00-B
Beuthel, Raymond L.	Draftsman	VI	225 00
Beveridge, W. T.	Draftsman	III	175 00
Beyer, A. C.	Chairman	IV	80 00-B
Bigelow, Allen A.	Axman	II	70 00-B
Binkley, George H. Jr.	Chairman	IV	80 00-B
Bixby, W. F.	Chief of party	VII	200 00-B
Blockley, Edward	Assistant engineer	IV	250 00
Blood, Chas. R.	Draftsman	Hdq.	200 00
Blotter, Wayne M.	Instrumentman	VII	130 00-B
Bock, Wm.	Assistant resident engineer	VI	200 00
Booker, B. W.	Draftsman	I	175 00
Bovey, Clarence	Resident engineer	III	250 00
Bowden, H. N. T.	Draftsman	Hdq.	155 00
Bowen, N. J.	Chief of party	IV	235 00
Brackett, Anthony	Instrumentman	V	125 00-B
Bradley, W. J.	Assistant clerk	VI	125 00
Brandon, Jack	Chairman	IV	85 00-B
Brandt, Robt. L.	Chairman	IV	85 00-B
Bransford, J. O.	Draftsman	I	150 00
Breuning, E. D.	Instrumentman	II	145 00-B
Breuning, O. D.	Resident engineer	IV	200 00
Brickel, C. T.	Draftsman	III	150 00
Briggs, Howard F.	Draftsman	VI	190 00
Brinkerhoff, O. B.	Instrumentman	IV	165 00
Brookey, W. W.	Instrumentman	IV	125 00-B
Brown, Ernest J.	Assistant resident engineer	IV	210 00
Brown, Eugene B.	Resident engineer	V	235 00
Brown, Mrs. Gladys	Assistant draftsman	II	105 00
Brown, James A.	Assistant file clerk	Hdq.	150 00
Brown, R. B.	Rodman	III	90 00-B
Bruner, Paul E.	Field draftsman	III	25 00-B
Buckley, R. F.	Clerk	VI	175 00



Name	Position	Division	Salary
Buckman, C. C.	Instrumentman	III	125 00-B
Bullivant, Earl J.	Chainman	IV	85 00-B
Burke, Raymond T.	Rodman	V	75 00-B
Burnett, C. G.	Chief of party	II	190 00-B
Burson, J. O.	Assistant resident engineer	VII	185 00
Busby, Forrest N.	Laboratory assistant	Hdq.	125 00
Butler, Frank A.	Assistant blueprinter	Hdq.	105 00
Butler, F. J.	Blueprinter	Hdq.	135 00
Butterworth, D.	Rodman	VI	75 00-B
Butts, C. M.	Resident engineer	III	240 00
Byrne, Eva B.	Clerk	III	110 00
Byrnes, Roscoe F.	Assistant resident engineer	IV	175 00
Caine, Chester L.	Assistant resident engineer	III	160 00
Cameron, E. M.	Resident engineer	I	235 00
Cameron, Florence	Stenographer	IV	140 00
Campbell, Lawrence V.	Draftsman	Hdq.	220 00
Cann, John G. Jr.	Rodman	V	80 00-B
Caprara, Geo. C.	Clerk	III	125 00
Carleton, C. C.	Attorney	Hdq.	425 00
Carlstad, Edwin	Assistant resident engineer	IV	175 00
Carmel, Marie L.	Stenographer	VII	110 00
Carpenter, B. J.	Chief of party	II	175 00-B
Carter, E. F.	Chainman	VI	75 00-B
Caruthers, Wm. S.	Assistant highway engineer	Hdq.	250 00
Case, Sohn A.	Assistant resident engineer	VI	100 00-B
Caske, Paul E.	Assistant resident engineer	VII	175 00
Casmore, N. C.	Levelman	II	120 00-B
Cass, A. B. Jr.	Chainman	VI	60 00-B
Caton, H. F.	Axman	II	70 00-B
Chamberlain, B. E.	Draftsman	V	175 00
Chapman, Harvey M.	Chainman	IV	85 00-B
Chapman, W. F.	Resident engineer	V	230 00
Charonnat, Adelaide	Clerk-typist	III	100 00
Cherry, Thos. C.	Chainman	IV	85 00-B
Chessman, Clarence	Assistant photostat operator	Hdq.	140 00
Chipman, Clay	Draftsman	Hdq.	160 00
Christie, W. H.	Junior equipment engineer	II	170 00
Christy, W. J.	Draftsman	II	150 00
Church, Hartly R.	Draftsman	III	175 00
Clapp, Rodger	Chainman	VI	110 00
Clark, Kenyon	Draftsman	V	175 00
Clark, M. A.	Draftsman	VII	150 00
Clark, W. H.	Draftsman	V	175 00
Clark, W. Lewis	Assistant highway engineer	Hdq.	400 00
Cleary, R. F.	Computer	I	125 00
Cleaveland, A. B.	Assistant division engineer	VII	285 00
Coburn, Wm. S. Jr.	Chainman	VII	90 00-B
Coffin, Cyrus W.	Chief clerk	VII	200 00
Coghill, J. W.	Clerk	Hdq.	115 00
Cole, Arden C.	Axman	I	80 00-B
Cole, Cyrus J.	Rodman	I	90 00-B
Cole, J. F.	Instrumentman	IV	140 00-B
Coleman, Arthur V.	Draftsman	IV	175 00
Comly, Harry S.	Assistant division engineer	II	300 00
Compton, W. W.	Resident engineer	I	175 00-B
Connelly, John L.	Assistant resident engineer	II	140 00-B
Connelly, T. J.	Assistant resident engineer	V	175 00
Connelly, M. F.	Rodman	II	95 00-B
Coonrod, A.	Assistant resident engineer	V	175 00
Cooper, Dwight B.	Chief of party	VII	235 00
Cooper, J. D.	Instrumentman	II	150 00-B
Coote, Norman	Locating engineer	VI	195 00-B
Copsey, Alma L.	Axman	I	85 00-B
Corey, L. C.	Draftsman	VII	135 00-B
Corfield, Shirley T.	Assistant division engineer	VI	285 00
Cortelyou, S. V.	Assistant division engineer	VII	325 00
Crabb, Mrs. Anna E.	Clerk	Hdq.	100 00
Craig, R. S.	Rodman	VII	95 00-B
Cramer, I. F.	Clerk	I	150 00

Name	Position	Division	Salary
Cramer, Jos. B.	Draftsman	I	125 00
Craun, E. L.	Rodman	III	90 00-B
Crogham, Charles C.	Rodman	II	85 00-B
Crogham, Orley B.	Rodman	II	85 00-B
Crompton, LeRoy	Chainman	VI	60 00-B
Cromwell, C. C.	Rodman	I	90 00-B
Cromwell, Harry T.	Chainman	II	75 00-B
Cropsey, B. I.	Assistant accountant	Hdq.	150 00
Crosby, Wm. A.	Assistant resident engineer	VI	175 00
Cummings, S. A.	Levelman	VII	125 00-B
Cushman, F. H.	Draftsman	Hdq.	190 00
Czelkowitz, R. R.	Resident engineer	I	190-00-B
Dabney, Harland	Chainman	IV	85 00-B
Dallas, Eli	Draftsman	II	225 00
Daly, J. R.	Cook	IV	50 00-B
Daniels, A. F.	Rodman	V	80 00-B
Darling, H. C.	Assistant engineer	III	235 00
Darlington, F. G.	Draftsman	IV	200 00
Darrow, C. C.	Chief clerk	I	175 00
Daugherty, Edythe M.	Stenographer	Hdq.	4 50 day
Davidson, F. D.	Instrumentman	VI	125 00-B
Davidson, Georgina D.	Stenographer	Hdq.	100 00
Davidson, Mrs. H. M.	Assistant secretary and assistant disbursing officer	Hdq.	170 00
Davidson, John B.	Draftsman	II	225 00
Davis, F. E.	Draftsman	II	200 00
Dawson, Ida	Stenographer	Hdq.	100 00
de Carbonel, Wm.	Chainman	VI	65 00-B
DeCew, L.	Rodman	IV	85 00-B
Decker, V. S.	Chainman	II	80 00-B
DeLancey, Clinton C.	Assistant resident engineer	VI	195 00
Dempsey, M. B.	Stenographer	V	90 00
Dennis, T. H.	Assistant engineer	III	275 00
Desmond, A. J.	Axman	II	70 00-B
Devers, Morris	Rodman	III	80 00-B
Devine, Wm. P.	Clerk	VII	100 00-B
Diamont, Nellie	Clerk	VII	160 00
Dickerson, Alice	Clerk	II	125 00
Dieterich, T. F.	Levelman	VI	100 00-B
Dieterich, George T.	Rodman	VI	120 00-B
Dingle, C. O.	Resident engineer	III	235 00
Douglas, W. A.	Chainman	I	90 00-B
Dowling, Gerald	Draftsman	VI	150 00
Dozier, D. T.	Rodman	V	90 00-B
Driver, Mrs. Viola	Clerk	Hdq.	90 00
Dudley, E. L.	Axman	II	80 00-B
Duffy, Raymond P.	Assistant resident engineer	IV	165 00
Duffy, Wm. T.	Assistant resident engineer	II	150 00
Duggan, Helen F.	Assistant draftsman	II	105 00
Dull, Oscar S.	Clerk	Hdq.	135 00
Duncan, Wm.	Axman	I	70 00-B
Dunckhorst, Paul	Assistant resident engineer	III	185 00
Dunkeson, Fern	Stenographer	Hdq.	90 00
Dunkley, L. R.	Assistant resident engineer	V	160 00
Dunn, Robt. I.	Assistant resident engineer	IV	175 00
Eastman, Harry R.	Rodman	V	75 00-B
Eaton, W. D.	Assistant resident engineer	VII	190 00
Edes, Edward L.	Field draftsman	I	140 00-B
Edinger, F. S.	Axman	I	75 00-B
Edwards, Helen A.	Clerk	III	140 00
Eggert, Robt. J.	Assistant draftsman	III	85 00
Elliott, Cyrus C.	Computer	I	115 00
Elliott, Jessie M.	Stenographer	VII	100 00-B
Elwood, Jas. F.	Draftsman	VII	200 00
Erskine, Neil M.	Rodman	I	100 00-B
Eskilson, Walter E.	Field draftsman	II	160 00
Evans, C. F.	Chainman	II	80 00-B
Evans, L. C.	Assistant resident engineer	II	160 00
Farrell, Joseph M.	Rodman	III	90 00-B
Faustman, Wm. F.	Draftsman	III	200 00
Feeny, Katherine A.	Employment clerk	Hdq.	170 00

Name	Position	Division	Salary
Fifield, Emma E.	Clerk	III	125 00
Fischer, Herman	Draftsman	II	180 00
Fite, Joseph S.	File and contract clerk	Hdq.	165 00
Fleming, M. R.	Chairman	III	90 00-B
Fletcher, H. O.	Assistant resident engineer	VII	175 00
Fonteneau, Chas. U.	Designing engineer	Hdq.	200 00
Ford, Warren	Chairman	VII	95 00-B
Forsberg, Geo. W.	Draftsman	IV	165 00
Fosgate, M. C.	Assistant resident engineer	IV	190 00
Foster, Herbert C.	Resident engineer	VII	235 00
Frain, Alfonso	Cook	II	110 00-B
Frank, Robert J.	Clerk	Hdq.	125 00
Frasier, Mrs. Billie	Stenographer	Hdq.	125 00
Freer, Leslie B.	Stenographer	Hdq.	125 00
Frey, Harry A.	Chairman	IV	90 00-B
Frey, Wm. O.	Chairman	IV	85 00-B
Frohwitter, C. L. J.	Traffic superintendent	Hdq.	250 00
Gallagher, James	Draftsman	Hdq.	180 00
Gale, Gordon C.	Draftsman	Hdq.	200 00
Games, Chas. E.	Assistant resident engineer	VII	185 00
Garber, Wm. F.	Assistant resident engineer	VI	175 00
Gardner, E. D.	Transitman	I	145 00-B
Gedden, Marion L.	Stenographer	II	125 00
George, A. N.	Resident engineer	VII	235 00
Gerson, Geo. B.	Civil engineer aid.	Hdq.	150 00
Gibson, Lester H.	Division engineer	V	400 00
Gibson, Ralph	Chairman	I	80 00-B
Gillfillan, J. A.	Draftsman	IV	185 00
Godfrey, David E.	Draftsman	Hdq.	200 00
Godwin, Merle H.	Computer	I	125 00
Goforth, Percy	Chairman	V	65 00-B
Goldsmith, Louis C.	Chairman	III	75 00-B
Goodchild, Cecil W.	Rodman	V	65 00-B
Gough, Wm. J.	Assistant highway engineer	Hdq.	325 00
Gowdy, L. H.	Draftsman	III	165 00
Grace, C. S.	Assistant resident engineer	VII	185 00
Graham, Raymond	Axman	I	85 00-B
Graves, Gordon F. W.	Rodman	VII	85 00-B
Graves, Max C.	Chairman	VII	85 00-B
Gray, John W.	Instrumentman	IV	135 00-B
Grebitus, E.	Rodman	III	80 00-B
Greeley, Douglas H.	Instrumentman	III	200 00
Greeley, John W.	Rodman	VI	175 00-B
Green, Herman	Chairman	II	85 00-B
Green, Paul F.	Assistant resident engineer	II	185 00
Green, R. R.	Draftsman	I	190 00
Greene, Chas. L.	Draftsman	III	175 00
Greer, Myron E.	Assistant draftsman	III	135 00
Greer, W. W.	Instrumentman	II	140 00-B
Gregory, Frank C.	Transitman	I	140 00-B
Gribble, E. J.	Assistant resident engineer	II	150 00-B
Griffen, A. D.	Resident engineer	VII	200 00
Griffen, Geo. T.	Weighmaster	III	125 00
Griggs, Sidney W.	Draftsman	Hdq.	190 00
Grumm, Fred	Assistant engineer	Hdq.	235 00
Guion, Earl K.	Chief draftsman	I	235 00
Gunter, Ethel V.	Stenographer	III	90 00
Gurrard, James W.	Leveler	I	125 00-B
Guthrie, Kenneth W.	Traffic regulation inspector	Hdq.	150 00
Hadley, Wm. H.	Instrumentman	VI	100 00-B
Hague, Lulu V.	Stenographer	II	135 00
Hague, Carl	Draftsman	II	225 00
Hall, John S.	Chairman	IV	85 00-B
Hall, John W.	Instrumentman	IV	125 00-B
Hall, Lester C.	Cook	VI	75 00-B
Halter, Regis E.	Instrumentman	II	145 00-B
Hamilton, Frank A.	Axman	I	75 00-B
Hammill, H. B.	Assistant test road engineer	Hdq.	250 00
Hampton, George	Chief of party	III	190 00-B
Hansen, C. J.	Cook	II	100 00-B
Hanson, George C.	Draftsman	III	210 00

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Name	Position	Division	Salary
Hanson, Mac	Stenographer	I	125 00
Harden, Grover C.	Levelman	VI	110 00-B
Hardenbrook, H. L.	Axman	I	75 00-B
Harding, Robt. H.	Chief of party	V	165 00-B
Harper, Harry N.	Draftsman	III	125 00
Harrah, Noble	Chainman	VI	60 00-B
Harrison, Alfred A.	Clerk	Hdq.	140 00
Harvey, J. McL.	Chainman	IV	85 00-B
Hazelwood, Fred W.	Assistant division engineer	I	300 00
Hatch, F. W.	Chief of party	V	130 00-B
Haugen, Harold M.	Draftsman	V	150 00
Haverstick, H. M.	Chief of party	VII	200 00-B
Hawkins, E. C.	Field draftsman	II	175 00
Hawthorne, Henry	Field draftsman	I	125 00-B
Hayes, Wm. L.	Resident engineer	II	235 00
Hayes, James T.	Clerk	V	165 00
Hayes, R. B.	Chainman	II	80 00-B
Healy, C. A.	Rodman	II	100 00-B
Heilman, J. S.	Rodman	VI	90 00-B
Heintz, C. F.	Assistant engineer	III	300 00
Henry, B. N.	Locating engineer	II	200 00-B
Henry, Leila M.	Cook	II	100 00-B
Hess, Rebecca	Draftsman	IV	150 00
Hewitt, F. C.	Resident engineer	III	225 00
Hiatt, H. M.	Chainman	I	80 00-B
Hickman, Alice	Stenographer	VI	100 00
Higgins, James E.	Rodman	IV	85 00-B
Hobbs, Ekimon L.	Rodman	I	90 00-B
Hodges, Joel B.	Assistant resident engineer	VII	185 00
Hofer, G. T.	Rodman	VI	75 00-B
Hogan, B. J.	Draftsman	IV	150 00
Holdsworth, Rich. B.	Clerk	V	175 00
Holt, Frank L.	Rodman	I	90 00-B
Holt, Palmer	Draftsman	I	200 00
Holman, W. H.	Instrumentman	V	115 00-B
Hoover, Mrs. Louisa J.	Cook	II	100 00-B
Horton, V. G.	Levelman	III	110 00-B
Houghton, Raymond	Chainman	I	90 00-B
Hoyle, Lancelot B.	Chainman	VI	75 00-B
Hoyle, Robert P.	Chainman	VI	75 00-B
Hubbell, I. D.	Chainman	IV	85 00-B
Hubbs, M. H.	Assistant resident engineer	I	170 00
Hudson, Ceell T.	Traffic regulation inspector	Hdq.	150 00
Huffman, H. L.	Chainman	VI	65 00-B
Hughes, H. Glover	Draftsman	IV	165 00
Hunt, Robert L.	Rodman	VII	100 00-B
Hunter, H. C.	Assistant highway engineer	Hdq.	350 00
Hunting, J. L.	Axman	VI	90 00
Hurley, Jack H.	Chainman	IV	80 00-B
Hutchinson, J. W.	Chainman	VI	110 00
Huxley, H. M.	Clerk	V	125 00
Hveem, F. N.	Assistant resident engineer	II	165 00
Hydle, M. L.	Draftsman	VII	200 00
Inman, Wm. P.	Assistant draftsman	V	115 00
Irish, Archibald C.	Levelman	III	110 00-B
Irish, Wm. H.	Levelman	III	110 00-B
Irvine, Jack B.	Laboratory assistant	Hdq.	80 00
Ivie, Horace E.	Resident engineer	III	225 00
Ivie, N. A.	Chief of party	III	190 00-B
Jackson, A. P.	Chainman	VI	75 00-B
James, C. V.	Assistant engineer	I	275 00
James, Edwin T.	Axman	II	70 00-B
James, Percy O.	Assistant resident engineer	IV	175 00
Janes, Arthur F.	Rodman	V	75 00-B
Jansen, Fritz	Chainman	III	65 00-B
Jencks, C. L.	Levelman	II	140 00-B
Johnson, Clyde F.	Assistant resident engineer	IV	140 00
Johnson, Emanuel	Chief of party	IV	140 00-B
Johnson, Hamilton C.	Draftsman	IV	165 00
Johnson, Harry D.	Chainman	VII	85 00-B

Name	Position	Division	Salary
Johnson, Sylvia	Stenographer	II	125 00
Johnson, W. H.	Locating engineer	II	200 00-B
Jones, Charles W.	Draftsman	Hdq.	200 00
Jones, Will C.	Assistant resident engineer	III	175 00
Joyner, F. H.	General inspector, Southern District	Hdq.	375 00
Joyner, Helen C.	Stenographer	IV	100 00
Judd, Geo. M.	Axman	II	85 00-B
Judd, Hubert O.	Draftsman	IV	165 00
Junkans, Elmer W.	Rodman	III	90 00-B
Kaleschke, E. J.	Draftsman	IV	175 00
Katz, Florence	Computer	IV	120 00
Kelsey, Lawrence D.	Instrumentman	VI	115 00-B
Kelton, John C.	Chief of party	II	160 00-B
Kernberger, Edw.	Axman	I	75 00-B
Kerr, Geo. H.	Chainman	I	75 00-B
Kimmel, John	Chainman	VI	165 00-B
Kimmel, J. H.	Resident engineer	V	225 00
King, Max L.	Rodman	VI	75 00-B
Kinyon, Carl	Instrumentman	II	135 00-B
Kinyon, J. E.	Rodman	II	100 00-B
Kirk, J. B.	Levelman	VI	80 00-B
Kirk, Kenneth	Instrumentman	VII	160 00
Kitts, J. A.	Resident engineer	I	230 00
Kleiniecke, A. L.	Draftsman	II	150 00
Knapp, James	Assistant draftsman	III	125 00
Knight, L. L.	Draftsman	V	190 00
Knall, L. G.	Computer	I	135 00
Kring, Jens	Chainman	I	80 00-B
Koll, Garton	Rodman	II	95 00-B
Kolster, G. G.	Resident engineer	VII	235 00
Krefting, E. T.	Clerk	II	120 00
Kreidler, J. H.	Assistant engineer	IV	265 00
Kring, Siren	Chainman	I	90 00-B
Labbe, R. H.	Assistant resident engineer	II	150 00-B
Lack, Billy	Weighmaster	III	125 00
Lacky, J. M.	Assistant resident engineer	VI	175 00
LaForge, Harold	Instrumentman	III	125 00-B
Langford, Dave	Clerk	V	125 00
LeBarge, J. H.	Chainman	VI	75 00-B
Lee, Sidney T.	Rodman	VI	80 00-B
Lehman, Benj.	Bookkeeper	Hdq.	160 00
Lehman, C. J.	Rodman	III	90 00-B
Leland, C. C.	Chief of party	VII	200 00-B
Lentz, W. J.	Chemist	Hdq.	200 00
Leslie, A. E. H.	Rodman	II	100 00-B
Leslie, J. V.	Levelman	II	120 00-B
Lichthardt, C. H. P.	Testing engineer	Hdq.	250 00
Liming, Harry R.	Rodman	VI	125 00
Lippert, E. F.	Draftsman	IV	185 00
Lloyd, H. B.	Rodman	II	95 00-B
Locey, Ira H.	Chainman	I	80 00-B
Long, Martin L.	Rodman	VII	95 00-B
Longfellow, Vera B.	Stenographer	VII	125 00
Lopez, Frank J.	Rodman	V	75 00-B
Lord, Stanley	Rodman	VI	75 00-B
Lovering, Frank R.	Chainman	VII	85 00-B
Lund, Alexander N.	Instrumentman	II	140 00-B
Lyons, Eleanor	Clerk	VII	100 00
McBeath, Hazel	Clerk	Hdq.	85 00
McCarton, A. P.	Draftsman	II	225 00
McCarton, Alma W.	Clerk	II	100 00
McChesney, C. E.	Instrumentman	VII	125 00-B
McComber, Mattie	Stenographer	Hdq.	140 00
McConoghy, Robert	Chainman	VII	85 00-B
McCord, Hugh C.	Chainman	VII	85 00-B
McCoy, J. E.	Rodman	VI	85 00-B
McCrea, R. W.	Assistant draftsman	III	125 00
McCully, Thos.	Assistant purchasing agent	Hdq.	190 00
McCurdy, A. W.	Office engineer	Hdq.	280 00

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Name	Position	Division	Salary
McDavitt, J. A.	Chief of party	Hdq.	225 00
McDonough, M. P.	Assistant resident engineer	II	175 00
McDougal, L. E.	Resident engineer	III	215 00
McEwen, A. Roger	Instrumentman	III	140 00-B
McGilvray, Joseph J.	Instrumentman	III	125 00-B
McGuire, Thos. C.	Traffic regulation inspector	Hdq.	150 00
McLean, Walter	Assistant draftsman	Hdq.	115 00
McMains, Elzy W.	Assistant resident engineer	V	125 00
McManus, F. W.	Junior equipment engineer	Hdq.	200 00
McMillan, O. S.	Rodman	V	110 00
McMillan, L. C.	Chainman	VI	80 00-B
McNeely, John W.	Rodman	III	90 00-B
McNeely, L. R.	Assistant resident engineer	VII	175 00
McNeely, Wm. C.	Draftsman	III	185 00
McNeil, Willard E.	Rodman	V	90 00-B
McNiff, Michael G.	Chainman	V	65 00-B
McPartland, John W.	Draftsman	Hdq.	150 00
McPherson, K. R.	Draftsman	IV	150 00
McVay, I. R.	Rodman	II	90 00-B
Mabee, C. R.	Assistant testing engineer	Hdq.	175 00
MacCleave, A. R.	Resident engineer	II	235 00
MacCoshum, May	Stenographer	Hdq.	4 50 day
MacDonald, Donald	Rodman	III	80 00-B
MacDonald, John R.	Traffic regulation inspector	Hdq.	150 00
MacIsaac, Leonard A.	Chainman	IV	85 00-B
Mack, G. T.	Assistant resident engineer	VI	175 00
Maddocks, Fred T.	Testing engineer	Hdq.	285 00
Maher, Frank G.	Chainman	IV	85 00-B
Mahoney, Henry L.	Clerk	Hdq.	125 00
Mahoney, Wilkis C.	Rodman	V	75 00-B
Major, Geo. H.	Resident engineer	V	225 00
Maim, Vernon	Rodman	VI	75 00-B
Manhart, Forrest R.	Draftsman	Hdq.	160 00
Manlove, Wm. F.	Assistant resident engineer	IV	185 00
Mansfield, A. F.	Rodman	I	95 00-B
Markhoff, Carl S. T.	Assistant resident engineer	III	190 00
March, Lester	Levelman	II	100 00-B
Marsh, J. Ogden	Office engineer	VII	250 00
Marshall, C. F.	Resident engineer	IV	250 00
Marshall, L. G.	Assistant resident engineer	V	175 00
Marshall, W. P.	Resident engineer	V	235 00
Martensen, Olaf	Rodman	III	90 00-B
Martin, C. P.	Instrumentman	II	140 00-B
Martin, H. G.	Axman	II	70 00-B
Martin, Silas C.	Clerk	Hdq.	125 00
Martindale, Jas. E.	Clerk	III	175 00
Masson, Mrs. L. D.	Assistant draftsman	II	135 00
Mauger, L. A. C.	Instrumentman	VII	125 00-B
Mays, Rex	Rodman-truck driver	IV	100 00-B
Meacham, J. D.	Locating engineer	I	200 00-B
Meehan, A. J.	Draftsman	Hdq.	185 00
Melendy, H. B.	Levelman	I	135 00-B
Meredith, Wynn	Resident engineer	I	235 00
Merrill, Edwin O.	Chainman	I	70 00-B
Merrill, F. R.	Draftsman	I	150 00
Mesick, Fred P.	Draftsman	VII	175 00
Meskimons, J. R.	Resident engineer	VI	195 00-B
Messner, R. E.	Resident engineer	IV	235 00
Meyer, Jack G.	Chainman	III	85 00
Miles, Horace S.	Draftsman	VII	200 00
Miles, Ransom C.	Statistician	Hdq.	200 00
Miles, Ruth	Stenographer	III	125 00
Millard, B. T.	Resident engineer	III	225 00
Miller, F. H.	Cook	VII	80 00-B
Miller, Harlan D.	Assistant structural engineer	Hdq.	265 00
Miller, Hermine	Stenographer	Hdq.	100 00
Miller, W. C.	Assistant engineer	VI	225 00
Millner, F.	Chainman	VI	65 00-B
Milnor, Emerson	Rodman	VI	75 00-B
Minahan, D. J.	Field draftsman	II	125 00-B
Mitchell, R. A.	Clerk	I	125 00
Mohn, Don E.	Weighmaster	I	100 00-B



Name	Position	Division	Salary
Monroe, O. W.	Resident engineer	VII	200 00
Montgomery, C. P.	Resident engineer	VII	235 00
Moon, Claude C.	Chainman	II	80 00-B
Moore, A. T.	Chainman	II	90 00-B
Moore, B. B.	Chainman	I	125 00
Moore, C. C.	Rodman	II	100 00-B
Moore, Godwin O.	Draftsman	Hdq.	185 00
Moore, Lucile E.	Stenographer	II	115 00
Moore, Robert B.	Clerk	Hdq.	85 00
Moorehead, Clyde S.	Transitman	III	125 00-B
Moran, John G.	Instrumentman	II	160 00-B
Moran, S. A.	Instrumentman	II	145 00-B
More, J. C.	Assistant engineer	VII	250 00
Morehouse, Francis B.	Levelman	III	110 00-B
Morgan, H. T.	Chainman	IV	85 00-B
Morian, Harold L.	Draftsman	I	150 00
Moriarty, James A.	Clerk	IV	200 00
Morrison, Alson R.	Office engineer	VI	250 00
Morrison, Gertrude E.	Typist	Hdq.	100 00
Moss, Frank	Chainman	II	80 00-B
Moss, Geo. E.	Rodman	II	100 00-B
Moss, Robt. S.	Axman	II	110 00
Mounday, Harry	Laboratory assistant	Hdq.	155 00
Moy, Robt. L.	Draftsman	Hdq.	185 00
Moynahan, Mrs. P. M.	Clerk	Hdq.	140 00
Mulligan, Rose	Clerk	III	125 00
Murphy, D. B.	Draftsman	II	190 00
Murphy, Joe M.	Chainman	IV	85 00-B
Murray, Mrs. Hilma B.	Clerk-stenographer	Hdq.	115 00
Murray, Ralph V.	Rodman	VI	85 00-B
Murray, Roy A.	Secretary and disbursing officer	Hdq.	300 00
Murray, W. P.	Messenger and computer	Hdq.	125 00
Muse, E. M.	Photographer-draftsman	Hdq.	210 00
Nash, Albert M.	Draftsman	Hdq.	180 00
Nathan, Mrs. Alice	Switchboard operator	Hdq.	90 00
Neis, Edward W.	Chainman	VII	90 00-B
Nelson, Bertha S.	Stenographer	VI	120 00
Nelson, Harry	Resident engineer	VI	230 00
Nelson, Niles H.	Resident engineer	IV	230 00
Nelson, W. J.	Assistant resident engineer	VI	165 00
Nelson, W. T.	Rodman	II	100 00-B
Nervig, T. Hilmar	Clerk	Hdq.	115 00
Newkirk, Lee R.	Axman	II	70 00-B
Newlan, M. M.	Draftsman	VI	150 00
Noble, Howard	Chief of party	VII	200 00-B
Noble, Jackson	Clerk	Hdq.	125 00
Noble, Mrs. Marie H.	Cook	VII	80 00-B
Nugent, Frank A.	Draftsman	IV	160 00
Nulty, A. K.	Rodman	II	95 00-B
Nunan, T. J.	Clerk	I	125 00
Nurse, J. C.	Assistant resident engineer	VI	190 00
Oberteuffer, R. K.	Resident engineer	VI	230 00
O'Hara, Geo. D.	Assistant resident engineer	IV	150 00
O'Hara, Joseph F.	Assistant resident engineer	V	190 00
Olds, Edson B.	Chainman	II	80 00-B
Oliphant, C. F.	Rodman	II	95 00-B
O'Looney, Jas. F.	Rodman	II	90 00-B
Osgood, Warren G.	Chainman	II	85 00-B
Otis, Ira C.	Locating engineer	III	200 00-B
Owen, Frank W.	Chainman	III	80 00-B
Packard, Joseph	Draftsman	IV	165 00
Packard, L. D.	Resident engineer	VII	210 00
Parenti, John	Messenger	Hdq.	75 00
Parker, Vernile A.	Rodman	V	80 00-B
Partridge, Geo. J.	Assistant resident engineer	V	175 00
Passmore, Richard	Rodman	V	85 00-B
Patch, W. W.	Division engineer	VII	400 00
Patrick, Arnold E.	Chainman	III	80 00-B
Patterson, Ben F.	Axman	I	75 00-B

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Name	Position	Division	Salary
Payson, H. S.	Assistant resident engineer	VII	175 00
Peacock, H. J.	Assistant draftsman	III	125 00
Pearce, H. J.	Assistant accountant	Hdq.	190 00
Pearce, Noel A.	Assistant draftsman	III	90 00
Pearl, Raymond J.	Chainman	III	90 00-B
Pearson, O. A.	Locating engineer	VI	150 00-B
Peck, W. E.	Draftsman	Hdq.	185 00
Peery, Wallace	Resident engineer	I	150 00-B
Penner, Gladys	Stenographer	Hdq.	100 00
Pennock, Edw. F.	Assistant resident engineer	III	135 00
Peppin, Earl M.	Axman	IV	85 00-B
Perry, Ray D.	Assistant resident engineer	IV	150 00
Peterson, W. H.	Draftsman	Hdq.	200 00
Peterson, P. Y.	Chainman	V	65 00-B
Pettit, Fred W.	Draftsman	VII	190 00
Phelan, H. J.	Axman	II	70 00-B
Philbrook, S. H.	Instrumentman	IV	165 00
Phillips, Walter I.	Clerk	Hdq.	135 00
Pierce, Mildred S.	Stenographer	VII	110 00
Pierce, Robert E.	Assistant engineer	III	275 00
Piper, John L.	Resident engineer	III	250 00
Polkinghorn, F. K.	Draftsman	III	175 00
Pollock, L. R.	Chainman	II	85 00-B
Pollock, Marvin J.	Axman	II	70 00-B
Pope, C. S.	Assistant highway engineer	Hdq.	300 00
Pope, St. George	Chainman	III	70 00-B
Porcella, Wm.	Rodman and truck driver	IV	100 00-B
Porter, Coral E.	Stenographer	Hdq.	100 00
Porter, Loyal C.	Draftsman	III	165 00
Posner, L. Fern	Stenographer	Hdq.	100 00
Poss, E. G.	Resident engineer	IV	210 00
Post, F. A.	Instrumentman	IV	130 00-B
Potashnick, Samuel	Draftsman	Hdq.	200 00
Potter, O. A.	Resident engineer	I	165 00-B
Potter, Ellis	Levelman	II	115 00-B
Potter, Stella L.	Assistant draftsman	II	100 00
Pratt, Newton T.	Draftsman	III	125 00
Preston, Pierce R.	Rodman	I	80 00-B
Price, Claude F.	Office engineer	IV	250 00
Price, W. J.	Instrumentman	I	125 00-B
Quigley, T. F.	Chainman	II	80 00-B
Quinn, Norman E.	Chainman	III	70 00-B
Ragan, H. C.	Resident engineer	VI	235 00
Raley, Ray E.	Draftsman	V	160 00
Ralston, Edith A.	Clerk	II	90 00
Ralston, L. A.	Clerk	II	125 00
Ramseier, Irvin B.	Draftsman	V	175 00
Ramsey, Clay	Axman	I	75 00-B
Ramsey, Mrs. Mabel	Cook	I	75 00-B
Ransom, Lida H.	Stenographer	VI	135 00
Ransom, Lyle M.	Resident engineer	VII	250 00
Ray, Albert	Chainman	VI	75 00-B
Ray, Elbridge W.	Draftsman	Hdq.	190 00
Read, Fred A.	Instrumentman	VI	125 00-B
Redden, Leo R.	Draftsman	VI	140 00-B
Reed, Mrs. Geneva M.	Cook	VI	75 00-B
Reed, Hazel D.	Typist	I	75 00
Reed, W. B.	Assistant resident engineer	VI	100 00-B
Reed, W. K.	Resident engineer	VI	250 00
Reeder, H. C.	Resident engineer	VII	235 00
Regan, C. F.	Clerk	Hdq.	150 00
Regli, Mrs. Vesta K.	Stenographer	Hdq.	125 00
Rehm, Norman	Chainman	VI	110 00
Remington, W. O.	Assistant resident engineer	III	175 00
Reupke, Howard T.	Resident engineer	VI	230 00
Reynolds, R. F.	Assistant resident engineer	II	125 00-B
Rhodes, W. T.	Instrumentman	VI	100 00-B
Richardson, Chas. S.	Draftsman	III	190 00
Richmond, Jos. L.	Assistant resident engineer	IV	115 00-B
Rimmele, Carl L.	Draftsman	VII	190 00

Name	Position	Division	Salary
Ringen, Wm. H.	Draftsman	Hdq.	200 00
Robbles, Walter T.	Axman	II	70 00-B
Robertson, Alex S.	Rodman	III	75 00-B
Robinson, Herbert	Rodman	IV	90 00-B
Rodgers, Thos. F.	Draftsman	II	200 00
Roe, Geo. M.	Mechanical inspector	II	150 00-B
Rordorf, Oscar M.	Field draftsman	V	160 00
Roseberry, T. A.	Assistant resident engineer	II	130 00-B
Rosenberg, O. M.	Resident engineer	VI	230 00
Rosendahl, Van W.	Draftsman	III	165 00
Roth, L. E.	Field draftsman	II	120 00-B
Ruebel, Ernest H.	Assistant resident engineer	VII	175 00
Ruiter, Mrs. Mable I.	Clerk	Hdq.	125 00
Russell, John R.	Chainman	VII	90 00-B
Rust, Clyde W.	Assistant resident engineer	III	160 00
Ryan, Matthew E.	Levelman	III	150 00
Ryan, Peter A.	Senior clerk	II	175 00
Ryder, Wayne C.	Chainman	III	65 00-B
Rylander, Geo. W.	Clerk	IV	175 00
Ryon, Chas. H.	Assistant accountant	Hdq.	175 00
Sampson, Seth W.	Instrumentman	IV	175 00
Sanders, Warren R.	Chainman	IV	85 00-B
Sands, A. W.	Instrumentman	II	140 00-B
Sapp, Dock	Instrumentman	I	140 00-B
Saunders, E. T.	Draftsman	II	175 00
Scanlon, J. P.	Messenger	III	75 00
Scheil, Arthur C.	Chainman	VI	75 00-B
Scheutzow, A. H.	Assistant draftsman	V	125 00
Schreiber, H. W.	Assistant engineer	IV	250 00
Scott, E. T.	Resident engineer	VII	235 00
Scott, J. R.	Rodman	II	90 00-B
Seadler, E. J.	Draftsman	Hdq.	200 00
Seitz, E. L.	Locating engineer	II	200 00-B
Sheffield, Mrs. M.	Assistant draftsman	II	90 00
Sheffield, Thos. E.	Chainman	IV	85 00-B
Shelly, Howard J.	Chainman	IV	85 00-B
Shelton, Frank	Cook	I	85 00-B
Sherwin, Vernon G.	Chainman	VI	60 00-B
Shinkwin, Chas.	Rodman	V	75 00-B
Shumway, F. P.	Assistant resident engineer	VII	185 00
Sibley, Howard L.	Chainman	I	80 00-B
Silverie, L. A.	Assistant resident engineer	V	175 00
Simard, Henry A.	Assistant resident engineer	IV	150 00
Simpson, Claude S.	Clerk	Hdq.	130 00
Skeggs, John H.	Division engineer	IV	360 00
Skelly, Harold	Axman	I	65 00-B
Skow, Alvin	Chainman	IV	85 00-B
Slaters, Claude	Axman	VII	75 00-B
Small, G. M.	Axman	II	70 00-B
Smedberg, Jos. D.	Draftsman	Hdq.	225 00
Smith, C. M.	Clerk	III	175 00
Smith, Clark R.	Chainman	III	85 00-B
Smith, Elmer L.	Assistant resident engineer	V	175 00
Smith, Glenn C.	Rodman	III	90 00-B
Smith, J. B.	Draftsman	VI	165 00
Smith, J. Geo.	Draftsman	IV	185 00
Smith, Mrs. Leona D.	Clerk	IV	160 00
Smith, Leonard D.	Assistant resident engineer	IV	155 00-B
Smith, L. Lloyd	Rodman	III	75 00-B
Smith, Lincoln T.	Stenographer-clerk	Hdq.	150 00
Smith, Lowell R.	Purchasing agent	Hdq.	250 00
Smith, Wallace A.	Assistant engineer	IV	235 00
Smith, W. A.	Resident engineer	III	235 00
Smith, W. H.	Assistant resident engineer	V	175 00
Sommer, Francis G.	Division engineer	I	400 00
Sorenson, Frank	Janitor	V	37 50
Southard, Frank D.	Traffic regulation inspector	Hdq.	150 00
Souza, Geo.	Truck driver	IV	6 00 day
Souza, M. E.	Rodman	V	90 00-B
Sowash, Geo.	Draftsman	V	175 00
Sparks, Mortimer E.	Secretary to highway engineer	Hdq.	200 00



Name	Position	Division	Salary
Speegle, Alvin M.	Axman	I	65 00-B
Spickard, H. E.	Draftsman	Hdq.	200 00
Spry, James E.	Draftsman	VII	150 00
Stahl, S. S.	Assistant division engineer	II	290 00
Stalnaker, Russell H.	Assistant highway engineer	Hdq.	350 00
Standley, J. C.	Office engineer	II	250 00
Standley, Ruth	Stenographer	II	100 00
Stanton, Thos. E.	Assistant state highway engineer	Hdq.	420 00
Steele, Alden J.	Weighmaster	III	125 00
Steele, Geo. A.	Draftsman	Hdq.	175 00
Stetson, Fred K.	Draftsman	VII	135 00
Stephane, Bessie	Typist	Hdq.	100 00
Stevenson, Ernest	Resident engineer	V	215 00
Stewart, J. E.	Draftsman	III	185 00
Stilson, F. C.	Draftsman	VII	150 00
Stockard, J. J.	Resident engineer	I	235 00
Stocks, Christopher R.	Messenger	Hdq.	65 00
Stone, Herbert E.	Draftsman	IV	165 00
Stonebraker, Wm. J.	Draftsman	VI	160 00
Stover, Harvey	Draftsman	Hdq.	200 00
Street, Chas. M. Jr.	Instrumentman	VII	125 00-B
Strickling, A. J.	Rodman	III	85 00-B
Stump, Elmer L.	Resident engineer	VI	230 00
Stump, R. L.	Assistant resident engineer	V	200 00
Sturgeon, Robt. H.	Rodman	I	100 00-B
Sturges, Horace M.	Draftsman	III	160 00
Sturgill, Lee R.	Chainman	V	65 00-B
Sullivan, E. Q.	Resident engineer	II	235 00
Sullivan, Lorraine	Typist	Hdq.	100 00
Sullivan, Ted	Rodman	V	85 00-B
Sutherland, Harry A.	Rodman	V	85 00-B
Sutton, M. J.	Chief of party	IV	190 00-B
Sutton, W. E.	Laboratory assistant	Hdq.	125 00
Swallow, A. R.	Assistant resident engineer	VI	100 00-B
Sweet, Chas. P.	Assistant resident engineer	I	105 00
Swickard, A.	Assistant division engineer	V	275 00
Sylvester, B. E.	Draftsman	I	190 00
Tabor, Lawrence L.	Rodman	III	80 00-B
Talbot, Charles H.	Assistant resident engineer	IV	175 00
Tanner, H. J.	Draftsman	II	190 00
Taylor, Earle W.	Chainman	IV	80 00-B
Taylor, Mrs. Edna	Clerk	II	125 00
Taylor, Garland	Clerk	III	125 00
Taylor, J. W.	Axman	II	75 00-B
Taylor, L. H.	Associate highway engineer	II	285 00
Taylor, W. B.	Locating engineer	I	200 00-B
Temby, Clifford	Draftsman	Hdq.	190 00
Temby, Ralph P.	Assistant resident engineer	V	165 00
Templeton, W. I.	Assistant resident engineer	II	130 00-B
Ten Eyck, Chas. L.	Draftsman	VI	175 00
Thomas, Bennett T.	Rodman	I	85 00-B
Thomas, Chas. H.	Resident engineer	IV	210 00
Thomas, Ira G.	Assistant engineer	V	250 00
Thomas, R. L.	Locating engineer	I	200 00-B
Thomas, Thurman E.	Chainman	I	70 00-B
Thomas, Willis	Assistant resident engineer	VI	125 00-B
Thompson, A. E.	Draftsman	IV	175 00
Thompson, Chas. E.	Chainman	III	75 00-B
Thompson, Elizabeth	Clerk	VII	110 00
Thompson, G. R.	Clerk	VII	160 00
Thompson, Geo. W.	Assistant resident engineer	IV	185 00
Thompson, Wm. J.	Draftsman	II	200 00
Thompson, Winifred	Typist	Hdq.	100 00
Thorp, Chas. E.	Assistant purchasing agent	Hdq.	190 00
Thurman, Edward W.	Axman	VII	90 00-B
Tilton, Geo. A. Jr.	Resident engineer	V	225 00
Tinkler, C. R.	Assistant resident engineer	IV	175 00
Townsend, M. L.	Rodman	III	100 00
Tremper, R. A.	Locating engineer	II	200 00-B
Tresidder, Harold	Rodman	VI	65 00-B

Name	Position	Division	Salary
Tresidder, Martin T.	Chainman	VI	75 00-B
Trummer, David J.	Draftsman	V	135 00
Tullock, James E.	Computer	I	135 00
Turnbull, G. R.	Truck driver and chainman	IV	100 00-B
Turner, Dewey M.	Draftsman	I	145 00
Ulery, Meril B.	Assistant draftsman	III	100 00
Ulery, Mrs. M. B.	Stenographer	III	95 00
Ullom, Geo. A.	Assistant resident engineer	II	140 00-B
Unangst, Geo. H.	Assistant draftsman	V	110 00
Upham, James	Draftsman	V	175 00
Upton, G. B.	Locating engineer	VI	170 00-B
Urquhart, C. F.	Axman	II	70 00-B
Vance, Cameron	Rodman	III	80 00-B
Van Leeuwen, Earl G.	Draftsman	V	175 00
Van Valin, Earle D.	Weighmaster	I	90 00-B
Van Zandt, Don H.	Assistant resident engineer	I	140 00-B
Vandoit, Marie	Stenographer	V	90 00
Vaughn, Ima	Typist	VII	80 00
Veter, Arthur N.	Rodman	VI	75 00-B
Viekrey, J. W.	Chief of party	III	235 00
Vincent, Chas. E.	Chainman	III	70 00-B
Vinson, Chas. E.	Chainman	IV	80 00-B
Vinzenhalor, B. W.	Instrumentman	V	125 00-B
Vogeli, Fred B.	Chainman	III	90 00-B
Voorhees, I. S.	General superintendent of maintenance	VII	300 00
Voss, T. W.	Assistant resident engineer	II	200 00
Wade, Geo. W.	Resident engineer	IV	235 00
Wagner, A. J.	Assistant highway engineer	Hdq.	350 00
Wagner, Geo. J.	Assistant resident engineer	IV	150 00-B
Wakefield, Allen N.	Instrumentman	VI	125 00-B
Walden, Esther	Typist	III	90 00
Walker, W. L.	Assistant resident engineer	VII	175 00
Wallace, Arthur	Assistant resident engineer	III	190 00
Wallace, Edward E.	Assistant division engineer	V	300 00
Wallach, Guss V.	Instrumentman	II	140 00-B
Waller, A. C.	Chief of party	III	225 00
Waller, J. F.	Locating engineer	VI	175 00-B
Walther, Lyle H.	Draftsman	II	160 00
Ward, Beverley T.	Draftsman	II	180 00
Ward, R. E.	Resident engineer	II	235 00
Warden, Wm. H. Jr.	Clerk	V	115 00
Warnick, W. G.	Instrumentman	II	140 00-B
Warrington, H. E.	Assistant highway engineer	Hdq.	400 00
Waterhouse, J. E.	Chainman	I	90 00-B
Waterman, H. A.	Acting office engineer	III	235 00
Weaver, Herman B.	Chief accountant	Hdq.	290 00
Webb, Bert A.	Field draftsman	VII	140 00-B
Webb, Henry G.	Chainman	I	85 00-B
Webb, T. R.	Axman	I	75 00-B
Weeks, C. H.	Instrumentman	III	140 00-B
Welch, Henry C.	Instrumentman	IV	125 00-B
Weinsheimer, E. C.	Draftsman	VII	190 00
Wellington, L. F.	Axman	II	70 00-B
Wells, Ross C.	Draftsman	IV	200 00
West, W. W.	Draftsman	IV	175 00
White, J. J.	Resident engineer	VI	195 00-B
White, Mrs. Mary E.	Cook	II	100 00-B
White, V. R.	Axman	I	75 00-B
Whitmore, Wayte	Chainman	VI	65 00-B
Whitney, Milton E.	Assistant draftsman	III	100 00
Wier, Edward H.	Draftsman	II	190 00
Wilcox, L. L.	Axman	I	85 00-B
Wilcox, P. L.	Instrumentman	VI	130 00-B
Wildy, H. H.	Chief of party	VII	175 00-B
Wilkes, R. C.	Draftsman	III	185 00
Wilkins, H. U.	Draftsman	IV	175 00
Willett, Albert B.	Draftsman	Hdq.	175 00
Willett, D. O.	Draftsman	Hdq.	225 00
Williams, Joseph A.	Levelman	II	120 00-B

Name	Position	Division	Salary
Williams, J. M.	Assistant draftsman	III	100 00
Williams, Mrs. Laura	Clerk	Hdq.	100 00
Williams, Mrs. Lizzie	Cook	II	100 00-B
Williams, L. H.	Draftsman	II	225 00
Willis, Edward D.	Chainman	III	90 00-B
Willits, Victor W.	Draftsman	Hdq.	200 00
Wilmann, H. Leo	Draftsman	IV	165 00
Wilson, Merle E.	Draftsman	II	150 00
Wilson, M. L.	Clerk	Hdq.	140 00
Wilson, Richard A.	Assistant resident engineer	IV	165 00
Winkelman, L. C. Jr.	Resident engineer	IV	275 00
Winslow, Geo. R.	Division engineer	III	400 00
Winslow, Jean P.	Draftsman	Hdq.	150 00
Wirsching, C. B.	Assistant division engineer	VI	285 00
Withycombe, Earl	Resident engineer	VI	230 00
Witt, S. N.	Draftsman	II	200 00
Wonacott, Austin	Chainman	VI	75 00-B
Woodbury, H. J.	Axman	I	75 00-B
Woodbury, Louisa	Cook	I	75 00-B
Woodin, Clarence	Draftsman	II	225 00
Woodson, James B.	Division engineer	VI	400 00
Wotton, Geo. E.	Draftsman	Hdq.	175 00
Wright, Thos. H.	Messenger	Hdq.	75 00
Wrigley, Noel T.	Chainman	III	70 00-B
Yerrin, Muriel	Stenographer	IV	120 00
Young, R. L.	Resident engineer	VII	300 00
Younggren, Judith	Stenographer	Hdq.	115 00
Zant, J. B.	Rodman	IV	90 00-B
Zehnder, R. A.	Draftsman	Hdq.	200 00



# ANALYSIS OF PAYROLL, CALIFORNIA HIGHWAY COMMISSION, JUNE 30, 1922.

	Div. I No. Emps. Avg. Salary	Div. II No. Emps. Avg. Salary	Div. III No. Emps. Avg. Salary	Div. IV No. Emps. Avg. Salary	Div. V No. Emps. Avg. Salary	Div. VI No. Emps. Avg. Salary	Div. VII No. Emps. Avg. Salary	Total No. Emps.	Avg. Salary									
Asst. State H. Engr.	1	420						1	420									
Asst. H. Engr. & Gen'l. Inspector	11	337						11	337									
Attorney	1	425						1	425									
Sec'y. & Disbursing Officer	1	500						1	500									
Testing Engineers	4	240						4	240									
Chief Clerk	1	200						1	200									
Laboratory Assn.	4	126						4	126									
Traffic Regulation Supt.	1	250						1	250									
Photostat Operators	2	175						2	175									
Blasprinters	2	120						2	120									
Division Engineers	1	400	1	400	1	360	1	400	7	394								
Asst. Div. Engineers	1	500	2	295	3	284	5	250	4	269	3	282	4	290	22	276		
Office Engineers	1	250	1	250	1	235	1	230	1	235	1	250	1	250	7	250		
Jr. Enlistment Engineer	1	200	1	170											2	185		
Resident Engineers	1	225	9	220	6	235	11	233	8	225	8	227	12	232	12	234	66	217
Asst. Resident Engineers	4	174	15	182	10	167	20	174	12	172	14	172	13	180	89	175		
Locating Engrs. Ch. of Party	3	235	7	224	5	229	3	212	2	183	4	209	6	231	30	221		
Draftsmen	12	170	25	190	17	172	26	169	24	163	10	171	15	160	166	179		
Asst. Draftsmen & Computer	1	115	7	156	7	116	13	106	1	150	3	117	1	125	33	117		
Instrumentation	5	173	13	178	9	165	10	167	3	160	7	162	6	153	53	164		
Levelmen	3	163	6	151	7	147			4	128	1	160	1	150	21	147		
Sodmen	10	156	21	139	18	118	7	116	17	113	14	112	5	130	92	121		
Chainmen	15	117	10	117	18	111	28	118	4	100	23	106	10	103	106	114		
Men	18	108	19	107							1	90	2	118	40	108		
Switch Board Op.	2	83													2	83		
Cooks	3	113	6	137			2	120				2	110	2	116	15	131	
*Clerks	59	145	4	144	6	141	10	131	3	178	5	141	3	159	6	145	76	144
Stenographers	17	112	2	125	5	120	4	103	4	120	2	90	4	114	4	120	42	113
Typists	4	100	1	75			3	94							1	80	9	93
Messengers	4	85					1	75									5	83
Relphaster			2	150			3	125									5	83
TOTALS	140		110	110	134	134	119	76	104	69					912			

\* Includes Assistant Engineers, General Superintendent of Maintenance and Mechanical Inspectors.  
\* Includes Chief Accountant, Purchasing Agent, Statisticians, Secretary to Highway Department, Secretary to Board of Public Works and other assistants, the whole or a portion of whose time is chargeable to other divisions of the Department of Public Works.

# Includes Assistant Engineers, General Superintendent of Maintenance and Mechanical Inspectors.  
 \* Includes Chief Accountant, Purchasing Agent, Statistician, Secretary to Highway Engineer, Secretary to Board of Public Works and other assistants.  
 ‡ The whole or a portion of whose time is charged to other divisions of the Department of Public Works.

**DAY LABOR EMPLOYEES NOT LISTED IN FOREGOING STATEMENT OF  
STAFF EMPLOYEES.**

Titles	Div. I		Div. II		Div. III		Div. IV		Div. V		Div. VI		Div. VII		Total No. Employees	Average Daily Wage		
	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage	No. Emps.	Avg. Wage				
Superintendents	1	8.00	3	7.54	7	8.71	12	7.22	2	7.14	3	7.35	1	8.54	4	8.10	33	7.66
Foremen	8	7.97	13	8.94	44	5.72	30	5.35	11	6.60	7	5.42	15	5.47	19	5.33	147	5.76
Sub-foremen			15	4.67			9	5.35	12	6.03	3	5.00	8	5.79	11	5.57	58	5.40
Clerks & Timekeepers	16	4.09	2	4.95	16	4.86	8	5.25	4	4.91			1	5.70	3	4.62	50	4.69
Steam Shovel Engineers			6	9.11	2	9.23											8	9.14
Gas & Steam Engineers			1	5.00			3	6.00	3	5.34	1	6.50	5	5.30	11	6.10	24	5.80
Mechanists	6	7.20					1	6.00							9	5.47	16	6.15
Mechanics	31	5.99	8	6.12	26	5.46	2	6.25	12	6.89	8	5.50	16	5.72	22	4.94	125	5.29
Truckdrivers	7	5.00	48	4.99	74	4.99	54	5.06	55	5.61	7	5.00	17	4.85	43	4.95	308	5.14
Tractor operators			6	5.08			2	5.00	1	6.00			2	4.76			11	5.09
Rollermen			4	5.50	3	5.00	4	6.00									11	5.91
Riot Operators			2	6.00									1	8.00			3	4.67
Blacksmiths	3	6.00	7	5.43	10	4.42	2	5.00	1	7.50	4	5.50	7	5.10	34	5.28		
Carpenters	11	6.92	7	6.28	22	4.90	4	5.87	3	7.33	5	5.46	13	7.15	65	6.06		
Painters	3	5.67															3	5.67
Powdermen			6	4.56	5	4.65	1	4.50	1	5.00			3	4.58	1	6.00	17	4.70
Drillers			23	4.04	7	4.09	2	4.50	9	4.50	4	3.75	6	4.67	51	4.20		
Gradersmen			8	4.69	4	4.25	4	4.50							16	4.24		
Teamsters			46	3.79	18	3.50	5	4.00			10	4.13	7	4.25	86	3.66		
Concrete Workers	10	7.08					11	4.95			23	5.30			44	5.62		
Skilled Laborers			6	4.42	1	6.60	1	4.50	16	6.30			1	4.75	3	7.56	28	5.93
Laborers	53	4.22	260	3.65	320	3.65	261	4.02	206	4.31	62	4.00	178	4.02	242	4.05	1582	3.93
Bridge-tenders			1	3.96			8	3.19	3	4.72							12	3.64
Guards			4	4.85	13	4.92											17	4.90
Watchmen			6	4.75			2	4.50					1	4.00			9	4.61
Cooks			9	4.82	7	5.67	5	3.17			1	5.20	5	4.74	5	3.69	32	4.89
Flunkies			5	3.14	9	3.17	1	2.60			1	2.95	7	3.37	7	2.47	30	3.02
TOTALS	149		495		598		430		544	116		284		413	2820			

# DIVISION OF ENGINEERING AND IRRIGATION.

Name	Position	Salary
Allin, Ray L.	Assistant hydraulic engineer.	\$250 00
Armstrong, Harry A.	Assistant civil engineer, grade IV.	235 0c
Bailey, Paul	Deputy chief of division	400 00
Bailey, E. A.	Flood control engineer	300 00
Barker, P. S.	Junior hydraulic engineer.	180 00
Bastow, J. G.	Engineering aid	150 00
Bishop, Mrs. Lucy A.	Clerk	135 00
Brown, J. B.	Irrigation engineer.	250 00
Bush, F. W. Jr.	Junior topographer.	160 00
Blote, M. H.	Assistant engineer, flood control.	200 00
Case, E. W.	Hydraulic engineer, grade IV.	250 00
Case, Ed. W.	Junior topographer.	160 00
Clinton, L. N.	Junior hydraulic engineer	170 00
Clyde, Geo. D.	Engineering aid	150 00
Culver, Amy C.	Stenographer, grade II.	110 00
Doolittle, H. E.	Engineering aid	125 00
Duncan, P. K.	Junior hydraulic engineer	170 00
Dunlop, Arthur C.	Junior hydraulic engineer	210 00
Eaton, E. C.	Irrigation engineer	350 00
Eisan, Ward.	Junior topographer.	160 00
Elsan, T. B.	Rodman	100 00
Elliott, J. A.	Junior topographer	160 00
Field, O. B.	Engineering aid	125 00
Feetham, C. E.	Hydro. assistant	115 00
Fankhouser, A.	Junior topographer.	160 00
Fitzgerald, G.	Junior topographer.	160 00
Graham, Harold M.	Rodman	100 00
Greer, Elbert P.	Messenger	75 00
Haley, J. J. Jr.	Assistant to chief.	275 00
Hilby, F. B.	Junior hydraulic engineer.	200 00
Hoffman, E. R.	Engineering aid	125 00
Hoy, W. W.	Civil engineer.	(day) 7 50
Ingerson, Irvin.	Engineering aid	125 00
Jessup, J. J.	Consulting hydraulic engineer.	300 00
Jones, Robert L.	Associate hydraulic engineer.	330 00
Johnson, O. F.	Junior hydraulic engineer	210 00
Kibbey, Biscoe A.	Junior hydraulic engineer	170 00
Lange, Raymond.	Rodman	100 00
Lovering, P. H.	Junior hydraulic engineer.	170 00
Leffler, J. E.	Gage tender	10 00
Manetta, W. J.	Junior hydraulic engineer.	200 00
Marlave, E.	Rodman	100 00
Marlave, Chester	Assistant hydraulic engineer.	250 00
Metcalfe, S. C.	Junior hydraulic engineer.	170 00
Meyer, C. B.	Junior hydraulic engineer.	190 00
McConnell, A. F.	Editor, Water Resources Report.	300 00
McKee, Redick H.	Junior topographer	160 00
McCready, H. L.	Assistant hydraulic engineer.	250 00
Newsome, L. O.	Junior topographer.	160 00
Neuman, T.	Junior hydraulic engineer.	170 00
Newton, C. M.	Junior hydraulic engineer	170 00
Nickerson, R. J.	Engineering aid	115 00
Peaslee, J. H.	Junior hydraulic engineer.	230 00
Perkins, W. A.	Assistant hydraulic engineer.	250 00
Post, Wm. S.	Associate hydraulic engineer	315 00
Pederson, L. S.	Rodman	100 00
Raab, Norman C.	Junior hydraulic engineer.	180 00
Reber, Bert A.	Civil engineering draftsman.	150 00
Rood, Glen	Junior civil engineer, grade III.	200 00
Rosecrans, Mrs. J. V.	Stenographer	125 00
Ruppel, Walter C.	Assistant hydraulic engineer.	250 00
Russell, G. H.	Assistant hydraulic engineer.	250 00
Raven, W. L.	Levelman	(day) 6 00
Scobey, Fred C.	Water resources engineer	315 00
Searancke, S. H.	Junior hydraulic engineer	200 00
Sheibley, E. G.	Assistant hydraulic engineer, grade IV.	250 00
Seggern, Otto von.	Junior civil engineering aid.	150 00
Smith, Burton.	Assistant hydraulic engineer.	250 00
Stafford, Earl D.	Junior topographer.	160 00
Seamands, Mrs. O. A.	Gage tender	10 00
Sulliger, H. N.	Junior hydraulic engineer.	170 00



Name	Position	Salary
Wooldridge, W. W.	River superintendent	200 00
Wilson, A. V.	Junior topographer	160 00
Williams, H. S.	Junior hydraulic engineer	220 00
Whitman, A. R.	Geologist	250 00
Worden, C. J.	Junior hydraulic engineer	170 00
Young, C. L.	Junior hydraulic engineer	190 00
Younggren, Myrtle O.	Typist	90 00

**ANALYSIS OF PAYROLL, DIVISION OF ENGINEERING AND IRRIGATION,  
JUNE 30, 1922.**

Title	Number employees	Average salary
Deputy chief of division	1	\$400 00
Assistant chief of division	1	275 00
Office engineer	1	330 00
Associate hydraulic engineer	1	315 00
Water resources engineer	1	315 00
Consulting irrigation engineer	1	300 00
Editor, Water Resources Report	1	300 00
Consulting engineer	1	(day) 25 00
Irrigation engineers	2	300 00
Geologist	1	250 00
Senior office engineers	7	229 38
Junior office engineers	22	167 05
Field engineers	6	235 00
Assistant engineer	1	160 00
Civil engineer	1	(day) 7 50
River superintendent	1	200 00
Hydrographers	3	193 33
Draftsmen	2	115 00
Draftsmen	2	(hr.) 75
Topographers	6	160 00
Levelmen	2	150 00
Rodmen	10	100 00
Clerk	1	135 00
Stenographers	4	105 00
Messenger	1	75 00
Gage tenders	2	10 00
Head packer	1	150 00
Assistant packer	1	100 00
Timekeeper	1	125 00
Total	85	

**Day Labor Employees.**

Laborer	1	\$85 00
Nightwatchman	1	(day) 1 25
Total	2	

**DIVISION OF WATER RIGHTS.**

Name	Position	Salary
Archer, L. J.	Rodman	\$80 00-B
†Arnold, Jesse	Engineer	151 62
*Atwater, W. W.	Referee	400 00
Baker, D. M.	Assistant hydraulic engineer	280 00
Beck, P. L.	Junior hydraulic engineer	175 00
Bosworth, A. P.	Junior hydraulic engineer	220 00
†Briggs, Roscoe C.	Engineer	190 62
Bryan, E. N.	Office engineer	235 00
Burchard, Dorothy	Stenographer	145 00
Burroughs, Spencer	Attorney	250 00
Burrows, Frank	Junior hydraulic engineer	160 00
Campbell, Mrs. Margaret	Stenographer	40 00
Cole, W. E.	Junior civil engineer	170 00
Conkling, Harold	Associate hydraulic engineer	300 00
Corwin, T. J.	Junior hydraulic engineer	150 00
Crane, D. R.	Special observer	10 00 wk.
Cross, Madge	Stenographer	125 00
Day, Dorothy	Stenographer	125 00
Dodson, E. S.	Janitor	90 00

†Cooperative work with United States Geological Survey.

\*Services intermittent.

NOTE.—Letter "B" indicates that board is furnished in addition to salary.

Name	Position	Salary
Fales, John C.	Junior hydraulic engineer	200 00
Fisher, H. Buford	Draftsman	150 00
*Harding, S. T.	Consulting irrigation engineer	25 00 day
Hill, Geo. M.	Junior hydraulic engineer	190 00
Hyatt, Edward Jr.	Executive engineer	300 00
Jamison, R. H.	Assistant hydraulic engineer	225 00
†Kelly, Kenneth M.	Engineer	166 25
Lamb, Albert L.	Rodman	90 00-B
Manwaring, Harry	Auto mechanic	75 00
Menzies, Aileen	Junior clerk	75 00
Mooney, Josephine	Stenographer	115 00
Murphy, Irene	Stenographer	125 00
Norris, Joseph W.	Rodman	75 00
Pearce, Laura	Senior clerk	150 00
Rider, Frederick	Topographer	160 00
Schroeder, Luella	Junior clerk	75 00
Simpson, T. R.	Junior hydraulic engineer	175 00
Smith, Adelaide	Chief clerk	200 00
Stafford, H. M.	Assistant hydraulic engineer	235 00
Troxell, Geo. E.	Assistant hydraulic engineer	170 00
Ueberhein, Maud	Senior clerk	130 00
Zander, Gordon	Assistant hydraulic engineer	280 00

†Cooperative work with United States Geological Survey.

\*Services intermittent.

NOTE.—Letter "B" indicates that board is furnished in addition to salary.

#### ANALYSIS OF PAYROLL, DIVISION OF WATER RIGHTS; JUNE 30, 1922.

Title	Number employees	Average salary
Executive engineer	1	\$300 00
Attorney	1	250 00
Office engineer	1	235 00
Hydraulic engineers	6	250 00
Junior hydraulic engineers	7	181 00
Hydrographers	3	169 49
Junior civil engineer	1	170 00
Draftsman	1	150 00
Topographer	1	160 00
Rodmen	3	116 67
Clerks	5	126 00
Stenographers	6	112 50
Auto mechanic	1	75 00
Janitor	1	90 00
Totals	39	\$169 62

NOTE.—One consulting irrigation engineer at \$25 a day, whose services are intermittent, and one special observer at \$10 a week are not included in the above analysis.

#### DIVISION OF LAND SETTLEMENT.

##### Berkeley.

Name	Position	Salary
Cummings, Gladys M.	Secretary-stenographer	\$140 00

##### Delhi.

Bailey, Wilbur G.	Assistant storekeeper	\$125 00
Beatty, A. E.	Engineer's helper	50 hr.
Beatty, Mary R.	Typist	3 50 day
Brown, Lloyd N.	Orchardist	200 00
Chivington, H. H.	Roustabout	60 00
Christie, Rosa	Typist	75 00
Cook, Max E.	Farmstead engineer	275 00
Fortier, Ernest O.	Engineer	235 00
Grant, Wm. J.	Concrete foreman	150 00
Hocker, Jefferson C.	Storekeeper	150 00
Kretz, Russel F.	Bookkeeper	150 00
Miller, William R.	Junior accountant	150 00
Packard, Walter	Superintendent	333 33

Name	Position	Salary
Peters, David C.	Foreman	7 50 day
Peters, Eva W.	Stenographer-secretary	100 00
Protheroe, Edward H.	Cost accountant	150 00
Said, Harry B.	Engineer	175 00
Shattuck, Oscar W.	Assistant accountant	225 00
Sillerman, John P.	Junior engineering aid, grade L	125 00
Temple, Thomas M.	Foreman pipe factory	175 00
Wasson, Iva	Stenographer	100 00

**Durham.**

Butler, F. M.	Ditch tender	185 00*
Dingman, H. H.	Accountant	125 00
Fogarty, Earl R.	Engineering assistant	85 00
Kreutzer, Geo. C.	Superintendent	163 67
Marshall, Margaret	Stenographer-cashier	100 00

\*Salary included furnishing of his own automobile.

**ANALYSIS OF PAYROLL, DIVISION OF LAND SETTLEMENT, JUNE 30, 1922.**

Title	Number employees	Average salary
*Superintendent	2	\$250 00
Farmstead engineer	1	275 00
Engineers	2	205 00
Junior engineers	4	102 50
Accountants	5	160 00
Stenographers and typists	7	100 86
Orchardist	1	200 00
Storekeepers	2	137 50
Total	24	

**Day Labor Employees.**

Foremen	4	\$148 75
Concrete workers	4	104 00
Pipe makers	9	107 00
Ditchers	21	83 33
Laborers	13	90 05
Total	51	

\*Part time one superintendent on outside work.

**DIVISION OF ARCHITECTURE.**

Name	Position	Salary
Abbott, Ernest	Carpenter	\$7 00 per day
Abram, T.	Carpenter	8 00 per day
Adams, Geo. J.	Deputy chief	335 00 per month
Adams, H. V.	Architectural draftsman	175 00 per month
Adams, R. P.	Junior estimator	180 00 per month
Aldrich, C. K.	Engineer estimates and costs	300 00 per month
Atram, M. W.	Carpenter	8 00 per day
Austgen, F. R.	Carpenter	8 00 per day
Axton, J. E.	Carpenter	8 00 per day
Barker, C. E.	Carpenter	7 00 per day
Basaglia, Peter	Cement worker	8 00 per day
Beakey, A. J.	Engineer assistant	200 00 per month
Beers, H. G.	Foreman	9 00 per day
Beik, F. A.	Mechanical draftsman	200 00 per month
Bergren, G. N.	Superintendent of construction	275 00 per month
Bradley, J.	Painter	8 00 per day
Breuillot, C. A.	Foreman electrician	9 00 per day
Craig, K.	Carpenter	8 00 per day
Campbell, Mrs. M.	Stenographer	40 00 per month
Cantoni, R.	Painter	6 00 per day
Cassie, L. W.	Carpenter	8 00 per day
Cerelli, J. E.	Painter	8 00 per day
Chamberlain, C. L.	Carpenter	7 40 per day and meals
Cheshire, Mae	Typist	85 00 per month



Name	Position	Salary
Cookson, E. S.	Painter	7 00 per day
Crosiar, C. R.	Painter	7 00 per day
Dane, Geo.	Hodcarrier	8 00 per day
Daniels, W. K.	Architectural draftsman	210 00 per month
Daum, Paul	Architectural draftsman	140 00 per month
Davies, S. R.	Electric draftsman	170 00 per month
Devine, H. J.	Architectural draftsman	190 00 per month
Dillon, F. M.	Foreman plumber	11 00 per day
Dutton, J. W.	General superintendent of construction	325 00 per month
Dwan, Ward	Estimator	225 00 per month
Dyer, C. O.	Carpenter	7 00 per day
Epperson, W. H.	Mechanical draftsman	210 00 per month
Eskill, R. M.	Architectural draftsman	140 00 per month
Fees, J.	Carpenter	8 00 per day
Figone, Fred	Hodcarrier	8 00 per day
Fisk, C. L.	Foreman carpenter	9 00 per day
Fritz, B. R.	Electrician	10 25 per day
Garthorne, G. E.	Electric draftsman	215 00 per month
Gillingin, Wm. Jr.	Lather	8 00 per day
Gilman, H. B.	Foreman carpenter	9 00 per day
Grant, H. V.	Superintendent of construction	300 00 per month
Gemmill, O. W.	Electrician	9 00 per day
Gorman, D.	Electrician	8 00 per day
Griffin, G. W.	Painter	8 00 per day
Hampton, E. W.	Architectural draftsman	125 00 per month
Hearst, E. G.	Electrician	9 00 per day
Heath, J. G.	Estimator	200 00 per month
Henderlong, C. A.	Mechanical draftsman	210 00 per month
Henderson, A. H.	Filing clerk	100 00 per month
Hernstedt, E. W.	Carpenter	8 00 per day
Hill, C.	Carpenter	8 00 per day
Hobson, J. L.	Steamfitter	9 25 per day
Holman, E. L.	Mechanical draftsman	135 00 per month
Hood, J. E.	Carpenter	8 00 per day
Hooper, M. T.	Assistant mechanical engineer	250 00 per month
Houck, Thomas J.	Electrician	9 00 per day
Hughes, J. J.	Carpenter	8 00 per day
Irwin, J. Fulton	Mechanical draftsman	135 00 per month
Irwin, J. R.	Electrician	8 00 per day
Jones, L. H.	Carpenter	8 00 per day
Kneppler, G. H.	Carpenter foreman	9 00 per day
Knox, James L.	Carpenter	8 00 per day
Koch, Elsa	Stenographer	125 00 per month
Krebs, A. B.	Assistant to superintendent	150 00 per month
Kromer, C. H.	Chief structural engineer	325 00 per month
Lavond, E. A.	Architectural draftsman	170 00 per month
Leedy, C. M.	Carpenter	8 00 per day
Lemmon, J. L.	Painter	8 00 per day
Lennox, M.	Stenographer	100 00 per month
Lewis, C. A.	Foreman painter	9 00 per day
Lewis, J. C.	Painter	8 00 per day
Locke, G. W.	Carpenter	8 00 per day
Long, W. J.	Structural draftsman	250 00 per month
Longfellow, G. A.	Foreman painter	9 00 per day
Loveland, G.	Plasterer	12 00 per day
Ludwig, John	Bricklayer	10 00 per day
Lynch, F. J.	Carpenter	8 00 per day
Martinez, G. F.	Foreman carpenter	9 00 per day
Mazzotti, Pio	Hodcarrier	8 00 per day
McBray, C. H.	Painter	8 00 per day
McMillan, D. H.	Structural draftsman	145 00 per month
McLaughlin, C. R.	Acting inspector	9 00 per day
Memmler, A. H.	Special writer	250 00 per month
Metzger, J. E.	Superintendent of construction	225 00 per month
Metzger, G. G.	Carpenter	7 00 per day
Miller, D. E.	Foreman carpenter	9 00 per day
Miller, L. B.	Architectural designer	275 00 per month
Montgomery, Z. J.	Foreman carpenter	9 00 per day
Morton, O. L.	Superintendent of construction	250 00 per month
Mullins, J. H.	Carpenter	8 00 per day
Neally, G. W.	Electrician	8 00 per day
Neary, J.	Bricklayer	11 00 per day

Name	Position	Salary
Nicol, David A.	Painter	6 00 per day
Noonan, Chas.	Bricklayer	11 00 per day
Norrbom, P. A.	Carpenter	7 00 per day
Norwood, E. A.	Carpenter	8 00 per day
O'Brien, L. W.	Painter	8 35 per day
O'Connell, Dan.	Steamfitter	9 25 per day
Palm, C. O.	Senior clerk	160 00 per month
Pembroke, L. B.	Plasterer	9 00 per day
Perozzi, John	Superintendent of construction	175 00 per month
Phillips, W. E.	Carpenter	7 00 per day
Pierson, C.	Junior estimator	210 00 per month
Poage, P. T.	Architectural draftsman	220 00 per month
Potts, W. K.	Civil engineer	230 00 per month
Proctor, J. R.	Carpenter	8 00 per day
Reid, I. P.	Painter	8 00 per day
Reis, Manuel Jr.	Carpenter	7 00 per day
Riboni, E.	Cement worker	7 00 per day
Richards, G. M.	Junior draftsman	75 00 per month
Robertson, Earl P.	Carpenter	7 00 per day
Robinson, F. J.	Mechanical inspector	215 00 per month
Rockingham, W. H.	Electric draftsman	230 00 per month
Ross, R.	Foreman electrician	10 00 per day
Rushton, L. E.	Mechanical draftsman	210 00 per month
Sahlberg, M. W.	Junior structural engineer	200 00 per month
Sargent, G. N.	Electrician foreman	220 00 per month
Simonson, G. M.	Chief electrical engineer	275 00 per month
Sherwood, L. F.	Chief architectural draftsman	250 00 per month
Smith, N. E.	Painter	8 00 per day
Smith, W. G.	Carpenter	8 00 per day
Stevenson, M.	Bricklayer	11 00 per day
Stevenson, L. L.	Carpenter	7 00 per day
Stewart, F. M.	Senior clerk	190 00 per month
Stockwell, Roy	Carpenter	7 00 per day
Strausser, H.	Carpenter	7 00 per day and maint.
Strubinger, A. A.	Junior draftsman	110 00 per month
Swanson, J. A.	Carpenter	8 00 per day
Tarver, B. C.	Superintendent of construction	225 00 per month
Tarver, J. V.	Carpenter	7 00 per day
Thorburn, Annie	Stenographer	125 00 per month
Tonascin, W.	Plumber	7 00 per day
Towle, Mrs. Thelma	Stenographer	95 00 per month
Waite, Geo. T.	Assistant structural engineer	235 00 per month
Walker, G. A.	Carpenter	8 00 per day
Warren, W. B.	Carpenter	8 00 per day
Warren, Wm.	Plumber	8 00 per day
Weber, C. M.	Superintendent of construction	250 00 per month
Weidner, C.	Foreman plumber	10 00 per day
Welch, Ray	Plasterer	10 00 per day
Weyl, Wm.	Painter	6 00 per day
Wiles, Dave	Hodcarrier	7 00 per day
Wilson, D.	Painter	8 00 per day

#### ANALYSIS OF PAYROLL, DIVISION OF ARCHITECTURE, JUNE 30, 1922.

Title	Number employees	Average salary
Deputy chief of division	1	\$335 00
Architectural draftsmen	8	171 00
Chief architectural draftsman	1	250 00
Junior estimators	2	195 00
Estimator	1	225 00
Engineer of estimates and costs	1	300 00
Junior structural engineer	1	200 00
Mechanical draftsmen	6	183 00
Mechanical inspector	1	215 00
Specification writer	1	250 00
Superintendent of construction	6	254 00
General superintendent of construction	1	325 00
Assistant to superintendent	1	150 00
Assistant mechanical engineer	1	250 00
Civil engineer	1	230 00
Engineer assistant	1	200 00

Title	Number employees	Average salary
Stenographers .....	5	105 00
Typist .....	1	85 00
Filing clerk .....	1	100 00
Electric draftsmen .....	2	200 00
Chief structural engineer .....	1	325 00
Assistant structural engineer .....	1	235 00
Structural draftsmen .....	2	197 50
Chief electrical engineer .....	1	275 00
Architectural designer .....	1	275 00
Senior clerk .....	2	175 00
Junior draftsmen .....	2	92 50
Total .....	53	

**Day Labor Employees.**

Carpenters .....	33	\$208 00
Cement workers .....	2	208 00
Foremen carpenters .....	7	234 00
Painters .....	15	195 00
Foremen painters .....	2	234 00
Electricians .....	6	221 00
Foremen electricians .....	4	253 50
Hodcarriers .....	4	208 00
Plumbers .....	3	198 90
Foreman plumber .....	2	280 00
Lathers .....	2	208 00
Steamfitters .....	2	240 50
Plasterers .....	4	265 20
Bricklayers .....	4	279 50
Total .....	90	









A STATE HIGHWAY IN HUMBOLDT COUNTY



PART II  
REPORT

of the

California Highway Commission

a subdivision of the

DEPARTMENT OF PUBLIC WORKS

of the

STATE OF CALIFORNIA

to accompany the

FIRST BIENNIAL REPORT

of that department

NOVEMBER 1, 1922

NEWELL D. DARLINGTON  
CHARLES A. WHITMORE  
GEORGE C. MANSFIELD

*California Highway Commission*

AUSTIN B. FLETCHER  
*State Highway Engineer*

THOS. E. STANTON  
*Assistant State Highway Engineer*

ROY A. MURRAY  
*Secretary*



CALIFORNIA STATE PRINTING OFFICE  
SACRAMENTO, 1922



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STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS

CALIFORNIA HIGHWAY COMMISSION

NEWELL D. DARLINGTON, Chairman  
CHARLES A. WHITMORE  
GEORGE C. MANSFIELD

AUSTIN B. FLETCHER.....State Highway Engineer  
THOS. E. STANTON.....Assistant State Highway Engineer  
CHARLES C. CARLETON.....Attorney  
ROY A. MURRAY.....Secretary

HEADQUARTERS OF THE COMMISSION: FORUM BUILDING,  
SACRAMENTO

RUSSELL H. STALNAKER.....ASSISTANT HIGHWAY ENGINEER  
(Equipment)  
H. E. WARRINGTON.....ASSISTANT HIGHWAY ENGINEER  
(Bridges)  
ALLAN J. WAGNER.....ASSISTANT HIGHWAY ENGINEER  
(General Field Inspection, Construction and Maintenance)  
W. LEWIS CLARK.....ASSISTANT HIGHWAY ENGINEER  
(General Field Inspection, Construction and Maintenance)  
F. H. JOYNER.....ASSISTANT HIGHWAY ENGINEER  
(General Field Inspection, Construction and Maintenance)  
W. S. CARUTHERS.....ASSISTANT HIGHWAY ENGINEER  
(Special Investigations and Reports)  
C. S. POPE.....ASSISTANT HIGHWAY ENGINEER  
(Testing and Research)  
W. J. GOUGH.....EQUIPMENT ENGINEER  
(General Field Inspection)  
A. W. McCURDY.....OFFICE ENGINEER

LOWELL R. SMITH.....PURCHASING AGENT  
HERMAN B. WEAVER.....CHIEF ACCOUNTANT

DIVISION OFFICES

Division

I. FRANCIS G. SOMNER, Division Engineer.....Willits  
II. T. A. BEDFORD, Division Engineer.....Dunsmuir  
III. GEORGE R. WINSLOW, Division Engineer.....Cal. Fruit Building, Sacramento  
IV. JNO. H. SKEGGS, Division Engineer.....Flood Building, San Francisco  
V. LESTER H. GIBSON, Division Engineer.....Union National Bank Building,  
San Luis Obispo  
VI. J. B. WOODSON, Division Engineer.....Rowell Building, Fresno  
VII. W. W. PATCH, Division Engineer.....Pacific Finance Building, Los Angeles

PAST MEMBERS OF THE CALIFORNIA HIGHWAY COMMISSION

Name	Residence	Date of appointment	Termination of membership
Burton A. Towne....	Lodi.....	August 2, 1911....	Resigned January 15, 1914
Charles D. Blaney...	Saratoga.....	August 2, 1911....	Resigned March 1, 1917
Charles F. Stern....	Eureka.....	January 15, 1914...	Resigned December 21, 1918
Henry J. Widenmann	Vallejo.....	March 1, 1917.....	Died October 6, 1918
Emmett Phillips....	Sacramento..	December 21, 1918.	Died June 18, 1919

# THE PEOPLE

LEGISLATURE

GOVERNOR

DEPARTMENT OF PUBLIC WORKS

DIRECTOR OF PUBLIC WORKS

DIVISION OF HIGHWAYS

CALIFORNIA HIGHWAY COMMISSION

STATE HIGHWAY ENGINEER  
EXECUTIVE OFFICER

ASST. STATE HIGHWAY ENGR.

DISBURSING OFFICER

STENOGRAPHERS

CHIEF ACCOUNTANT

ASST. ACCOUNTANT

CLERKS

STENOGRAPHERS

FILE CLERK

ASST. FILE CLERK

ASST. HIGHWAY ENGINEERS

GENERAL INSPECTION

SPECIAL ASSIGNMENTS

INVESTIGATIONS AND REPORTS

PURCHASING AGENT

ASST. PURCHASING AGT.

STENOGRAPHERS

ASST. HIGHWAY ENGINEER

PLANNING

ASST. BRIDGE ENGINEER

DESIGNERS

DRAFTSMEN

PERSONNEL CLERK

STENOGRAPHERS

ASST. HIGHWAY ENGINEER

EQUIPMENT

ASSISTANTS

CLERKS

STENOGRAPHERS

TYPISTS

HEADQUARTERS SHOPS

OFFICE ENGINEER

ASST. ENGINEERS

DRAFTSMEN

COMPUTERS

STENOGRAPHER

PHOTOGRAPHER

BLUE PRINTER

ASSISTANTS

7 DIVISIONS

DIVISION ENGINEERS

ASST. DIVISION ENGINEERS

CHIEFS OF PARTY

TRANSITMEN

LEVELMEN

FIELD DRAFTSMEN

CHAINMEN

RODMEN

COOKS

AXEMEN

ATTORNEY

STENOGRAPHER

RESIDENT ENGINEERS

ASST. RESIDENT ENGINEERS

SUPERINTENDENTS

FOREMEN

TIMEKEEPERS

CLERKS

DAY LABORERS

ORGANIZATION

AND

ACTIVITIES

1922

ASSISTANTS ENGAGED  
IN RESERVAIR WORK

# BIENNIAL REPORT

## OF THE

# CALIFORNIA HIGHWAY COMMISSION

NOVEMBER 1, 1922.

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### INTRODUCTORY.

The two years since the 1920 biennial report of the California Highway Commission have witnessed the greatest construction activity since the inception of work on the state system in 1912. This activity has not been confined to the building of new highways alone but has included a substantial beginning on a program of widening and thickening of main trunk highways. This was contemplated when the Commission adopted the unit type of construction by which it provided for a large mileage of usable roads so designed that their carrying capacity could be increased to keep pace with the demand of increasing traffic without loss of original investment.

Certain very definite reasons made it advisable, in the opinion of the Highway Commission, to undertake a large building program during this period. The registration of motor vehicles in California has increased over 1700 per cent since the first state highway bond issue was voted in 1910, and the demand for additional improved highways was increasing in intensity. The peak of excessively high building costs, that followed the war, passed and prices showed a sharp decrease. Contractors were eager for work. Unemployment was prevalent, and the fact that highway work employed a large volume of unskilled labor and was distributed over the entire state made it particularly desirable to undertake a large amount of highway construction.

Fortunately the electors of the state, by the enactment of Constitutional Amendment No. 9 at the previous November election, had provided a flexible rate of interest on state highway bonds which formerly had been difficult to sell on a fluctuating and uncertain bond market at the fixed interest rate of  $4\frac{1}{2}$  per cent. Under the authority of this measure the state was able to offer bonds at the market rate and thus was able to proceed with highway construction without interruption.

### EXTENT OF ACTIVITY.

The extent of the road building activity of the past two years will be realized when it is stated that in November, 1920, there were 28 contracts and day labor jobs under way on the state highway system involving 280 miles. On July 1, 1922, there were 152 contracts and day labor jobs with a total of 1063 miles. During the two year period 600 miles of state highway have been completed and 89 miles of the highway widened and thickened.<sup>1</sup>

<sup>1</sup>The mileage of state highways completed during the period includes 135 miles previously reported as having been graded only.



## COST OF COMPLETING HIGHWAY SYSTEM.

While the great activity in highway construction during the past two years has given the state the service of a large new mileage of improved road, it has also brought California face to face with the problem of refinancing its highway system.

On July 1, 1922, the amount of State Highway bond money left in the treasury plus \$16,000,000 in unsold bonds amounted to \$23,066,-027.30.

At the present rate of expenditure, this money will either be spent or obligated before the end of 1923. Accordingly the people of California must either refinance the work or be prepared to see a cessation of highway construction at the close of the coming year.

The highway problem is so intimately connected with the fortune and the social and material well being of every county and every community in the state that its solution is one of the most important issues before California. Owing to the very large sum involved the problem is more perplexing than it has ever been in the history of California.

### MONEY NEEDED.

How great an amount of money could be advantageously spent upon California's road system may be gleaned from a consideration of the mileage now in the system and the character and cost of the portion that has been improved as compared with the mileage yet to be improved.

The figures are as follows:

Total mileage in the state highway system.....	6,400
Completed mileage under bond issues (approximate).....	2,500
<hr/>	
Mileage still to be improved.....	3,900
(Exclusive of graded roads included in the improved mileage above, but some of which are yet to be paved or otherwise further improved.)	

Table showing mileage of bond issue roads constructed or improved by the California Highway Commission:

Earth and gravel .....	791 miles
Asphalt macadam .....	64 miles
Topeka on macadam .....	16 miles
Portland cement concrete bases.....	1,567 miles
Asphalt surface on concrete base.....	108 miles
Miscellaneous .....	10 miles
<hr/>	
Total .....	2,556 miles

The cost of the completed bond issue roads has averaged approximately \$20,000 per mile.

The average cost per mile of improving the remaining roads in the California state highway system, however, will probably be not less than \$25,000 and may be considerably more than this amount depending entirely upon the class of improvement adopted.

Most of the work to date on the system has been in the valley or hill sections of the state where the grading was comparatively light and pavement costs were relatively low, due to close proximity to rail facilities.



Plate I. State Highway, Ventura County from Point Mugu southerly showing rugged nature of country.



Plate II. State Highway, Ventura County. Point Mugu, showing proposed location.

By far, the greater part of the grading yet to be done is in mountainous country. To grade the Feather River highway only 12 feet to 14 feet wide is estimated to cost not less than \$30,000 per mile. Grading and graveling along the coast in Humboldt and Del Norte counties, grading and paving the Skyline Boulevard, grading and graveling the highway along the coast in Monterey and San Luis Obispo counties, and grading and paving along the coast between Oxnard and San Juan Capistrano in Ventura, Los Angeles and Orange counties will average in excess of \$50,000 per mile.

At \$25,000 per mile the cost of improving 3900 miles will amount to very nearly \$100,000,000, but this amount does not represent the total expenditures that must be made in California's highway system. It represents simply an estimate of the cost of improving to average specifications of past years the unimproved portions of the present state highway system, and the reconstructing of the old county-built macadam roads in Los Angeles, San Joaquin, Sacramento and several other counties, which have become a part of the state highway system.

To this must be added the cost of widening and thickening approximately 1200 miles of the present system and the elimination of grade crossings. These two latter items will cost about \$35,000,000 additional.

Work in sight at the present time will, therefore, cost not less than \$135,000,000 to complete. Credited against this estimate of \$135,000,000 are funds remaining in the \$40,000,000 bond issue, Federal Aid funds that will be available under future Congressional appropriations, and allotments to projects now under way but not completed.

It should be noted that the above statement includes only items involving capital expenditures. Money for maintenance must be provided outside of this sum.

#### THE DEMAND FOR NEW ROADS.

Everywhere in the state, cities and counties are asking the inclusion in the state highway system of a large mileage of highway not now a part of the system, but for the inclusion of which very valid arguments are offered. The counties also are showing an increasing unwillingness to construct bridges on state highways, and the time appears to be not far off when bridge construction must be undertaken by the state along with the construction of the roadbed proper.

### NEW FINANCIAL POLICY ESSENTIAL.

It is obvious that California is facing the expenditure of many millions of dollars on highway work, in addition to the \$68,368,240<sup>1</sup> already spent. It is equally obvious that the amount involved is so large that the problem of distributing the burden of highway construction costs between this generation and succeeding generations and between the general taxpayers and the users of the road offers difficulties of large proportions to the people of California. The time has come when the hit-and-miss, happy-go-lucky plan under which the road work in California has been financed in the past must give way to a carefully thought out and scientifically planned policy of highway financing.

<sup>1</sup>Expenditures to July 1, 1922, including all items.





Plate III. State Highway, Ventura County, showing proposed location.



Plate IV. State Highway, Ventura County, showing proposed location.



## METHODS.

There are three methods of financing highway construction.

1. Construction on a pay-as-you-go plan.
2. Construction on a bonding or deferred payment plan.
3. Construction on a plan based in part on direct payments and in part on bonds.

## THE PAY-AS-YOU-GO PLAN.

The discussion of the relative merits or demerits of such a plan will of necessity center about the amount of money that is to be raised, the ability of the state to raise it, and the further question of the extent to which one generation should fasten an indebtedness upon succeeding generations.

It is the opinion of the Highway Commission that \$12,000,000 represents approximately the amount of construction that can be undertaken by the highway organization in a year of normal conditions, and that a much larger program is likely to result in loss of efficiency in the work. In this connection it is instructive to note that the average annual expenditure since the state highway work started in 1912 is \$6,800,000. The highest expenditure for any one year was \$14,144,742, and lowest expenditure was \$594,110. These figures cover, however, the war period and the year following the close of the war, when highway work in California and elsewhere largely marked time.

Taking the sum of \$12,000,000 as a basis from which to figure, the problem presents itself somewhat as follows: It may be expected that about \$2,000,000 will be received as the state's share of the Federal Aid Highway Appropriation (in 1923 the amount will be \$1,641,000; in 1924, \$2,134,000; and in 1925, \$2,462,000), and the remaining \$10,000,000 must be raised otherwise.

It is apparent that this money must be obtained either by increasing the revenue derived from motor vehicles or from the general tax of the state or both. Inasmuch as organizations of motor vehicle owners have gone on record against any plan of highway taxation that would place the burden of original construction on motor vehicle owners it is extremely doubtful if any plan intended to place the sole burden of road improvement on motor vehicles would receive serious consideration. The \$10,000,000 would therefore have to be taken from the general fund of the state. Such a plan would result in the saving of interest charges which under the bonding plan would have to be paid out of the general fund.

## THE BONDING PLAN.

The second method of highway construction is the bonding or deferred payment plan, the method that has thus far been adopted in California in constructing its highway system.

The advantage of the bond plan is that it makes funds immediately available for highway construction. The disadvantage is the increased cost of the road due to interest charges. Credited against this interest cost must be the service that the road will give for an estimated period of years between the date of its actual construction under a bond issue



Plate VI. State Highway, Mariposa County, between Mariposa and Briceburg, steam shovel at work.

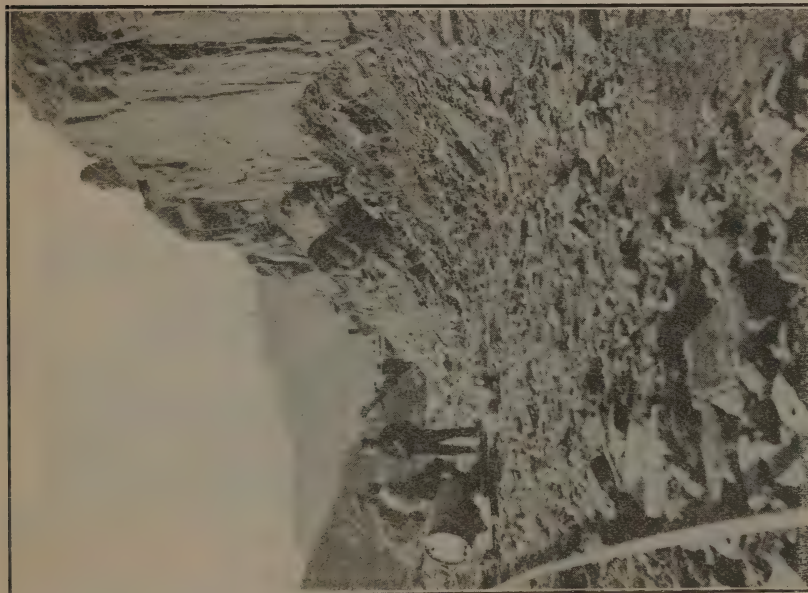


Plate V. State Highway, Mariposa County, between Mariposa and Briceburg, graded roadway under construction.

and the date of its probable construction under a pay-as-you-go plan. It is needless to add that California's highways have demonstrated an earning capacity far beyond the annual interest, bond refunding, and maintenance charges for each year.

In the question of a bond issue is involved the mooted question of the proper division of road costs between this and succeeding generations.

The generally accepted rule governing such distribution is that where a debt is passed from one generation on to another, sound assets equal in amount to that debt should also be passed on to the paying generation.

An analysis of highway financing in California will show that this has been done. Such misleading expressions as "long term bonds for short term roads" as applied to California highways and the highways of other states where road improvement has been carried on to any great extent are due to a misconception in the popular mind as to what a highway is. The surface is confused with the whole road.

#### ANALYSIS OF COST OF ROAD PARTS.

There is need to educate the public mind as to the component parts of the road, that people may know that the surface pavement is but a part and in fact the least permanent part of an improved road. The public needs to be informed that the pavement is always liable to show distress under excessive traffic, and that the really permanent portions of a highway are, the graded road bed, which usually improves with years under traffic; and the drainage structures.

Then, too, the pavement itself rarely becomes a total loss since, generally, it may be incorporated in the reconstructed pavement. In California hardly a section can be found where a pavement slab, weakened by unforeseen traffic, will not show a salvage value of from 75 to 90 per cent of its initial cost if it is made a part of a thicker and wider roadway.

Due regard to good engineering and good business in road construction will maintain a ratio between the cost of the pavement and the more permanent portions of an improved highway that will assure to future generations assets equaling in value and generally far exceeding the indebtedness they will be called upon to pay.

#### THE ILLINOIS PLAN.

Before closing the discussion of the second or bonding plan, the Illinois bonding plan is interesting to note:

The people of the State of Illinois in 1918 voted a \$60,000,000 state highway bond issue. These bonds are of the serial type, payable within twenty years. Both the principal and interest are calculated to be entirely met with motor vehicle license fees, without recourse to general taxation, hence throwing the entire burden on the road users.

#### THE THIRD PLAN.

The third plan of highway financing contemplates a large annual revenue supplemented by a bond issue, and it is this plan that seems best suited to meet California's need today.

Advocates of this plan in California would place the burden of original primary construction upon the general taxpayers through a



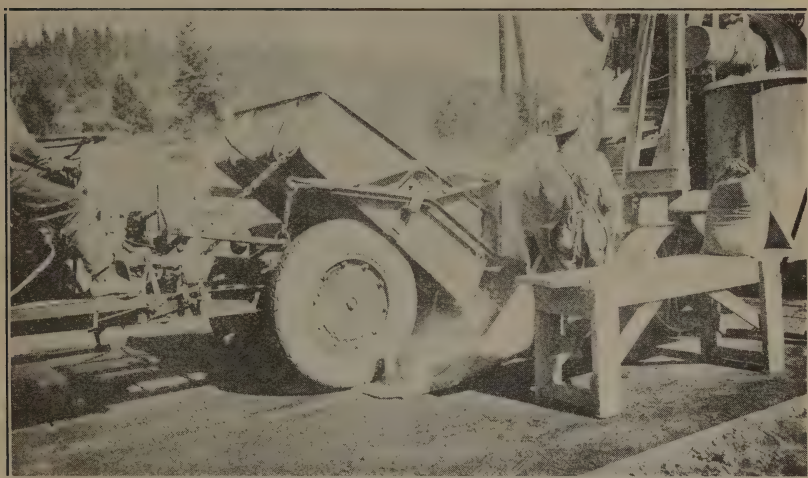


Plate VII. State Highway, Siskiyou County, typical construction scene.

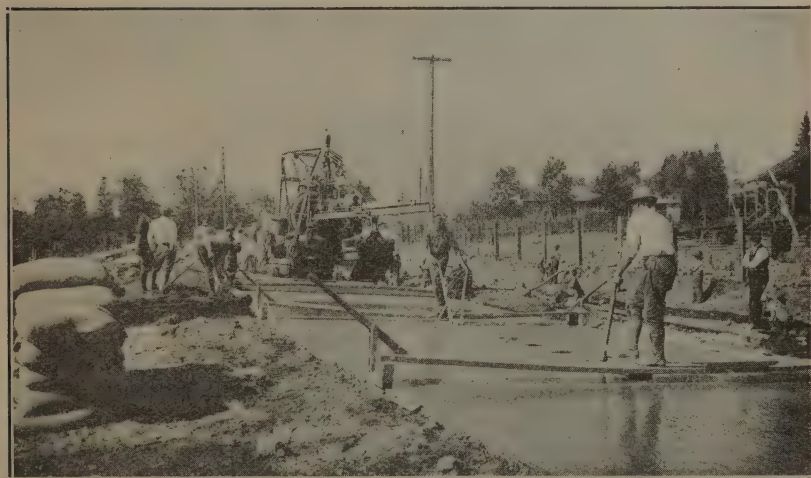


Plate VIII. State Highway, Siskiyou County, concrete base under construction.



bond issue. The burden of maintenance, of widening and reconstruction to accommodate increased traffic would be placed upon the users of the road.

The question of the extent to which the use of revenues shall be specified and limited is one for legislative determination. The necessities, however, of the California highway system would practically assure the distribution of revenues for some years to come substantially in accordance with the method outlined above.

#### **MORE MONEY FROM ROAD USERS.**

The Highway Commission has for over two years urged the adoption of measures that would place a larger share of highway costs upon highway users. Specific recommendations to accomplish this have been embodied in proposed legislation for a gasoline tax and for an increase and equalization in motor vehicle fees.

#### **GASOLINE TAX.**

The gasoline tax is now in successful operation in 17 states. It should be noted that the tax is ordinarily in addition to personal property taxes and the usual motor vehicle fees. The advantage of the gasoline tax is that it automatically distributes itself in proportion to road use; it can be collected from about six distribution companies and the cost of collection will be negligible; it will bring a large new revenue into the state from out-of-state cars that are attracted to California by the state's highway system, and which now enjoy the state's roads without contributing either to the cost of their construction or their upkeep.

There were approximately 350,000,000 gallons of gasoline used in California in 1921 of which 90 per cent was used in motor vehicles. It is the opinion of this Commission that a gasoline tax for road purposes should be levied only against gasoline used in motor vehicles and in the bill introduced in the 1921 session of the legislature, a simple method for exempting non-highway used gasoline was devised.

The need of the state highways is so great that the entire fund derived from such a source should be devoted to the state highways. For the next five years the entire amount so received can be expended in widening and thickening present highways and unless a larger tax is imposed than has heretofore been considered, additional revenues for these purposes will be needed.

#### **MOTOR VEHICLE FEES.**

In addition to the gasoline tax, an increase in motor vehicle fees is desirable not only as a revenue measure, but to equalize motor vehicle charges as between light passenger machines and the heavier duty trucks.

At the present time, California taxes motor vehicles upon a horsepower basis with the very nominal surcharge of \$5 and \$10 for trucks.

Under this plan an undue share of road maintenance falls upon the light passenger machine with its high horsepower capacity installed to give it speed. On the other hand the greatest injury to the highway



Plate IX. Placer County, 4000 sheep on Auburn-Verdi road, September 14, 1922.

comes from the truck, the horsepower installation of which is approximately that of the light car, but whose weight and impact on the road is infinitely more damaging.

#### INCREASE FEES WITH LOADS.

This Commission would recommend that the basis of motor vehicle fees be changed from the present basis of a horsepower tax with a nominal surcharge for trucks to a horsepower and gross laden weight basis. It is the opinion of the Commission that only a nominal increase should be made in the tax on horsepower but that a substantial fee should be charged on the basis of weight, the fee again increasing substantially as the load increases. To lessen impact damage, the Commission is also of the opinion that the use of pneumatic tires on trucks should be encouraged by making a substantial differentiation in the weight fee for trucks equipped with pneumatic tires as against those equipped with solid tires.

#### CHARGES IN OTHER STATES.

In making these recommendations, the Highway Commission fully recognizes that motor transportation is a proper, legitimate and essential development of the country's transportation system. At the same time a comparison between charges levied upon trucks and commercial vehicles in California and similar charges in nearly every other state of the Union shows that California is substantially lower in its scale of license fees than other states having improved roads and in fact many of the *unimproved road states* derive greater revenues from the commercial users of the highways than does California. This comparison clearly reveals that the changes suggested by this Commission impose no undue hardship or unfair charge upon the trucking industry.

The above plan which would make the traffic that has created the necessity for wider and thicker roads pay the cost of such improvement will also free the general taxpayers of a burden, which if they should be called upon to pay would increase their highway taxes by many millions of dollars.

#### COUNTIES WILL SHARE.

In this connection it should be noted that motor vehicle fees are shared with the counties and accordingly the counties would be the beneficiary with the state from increased revenues that would come from this source.

Motor vehicle moneys are used for maintenance. If any surplus exists, such surplus can well be used for widening and thickening highways.

#### FEDERAL AID FUNDS.

Consideration of the financing of the highways must of course take into account funds derived from the United States Treasury. To date California has received \$10,846,453.10 of these federal funds.



Plate X. State Highway, Santa Clara County, showing widened and thickened highway.



The federal funds apportioned to California up to June, 1919, were taken into consideration by the framers of the \$40,000,000 bond act. In the budget upon which this act was based, allotments totaling \$44,688,675 were made to various projects with \$40,000,000 in bonds to meet these budget allotments. It was understood that the additional \$4,688,675 would come from federal funds and from a small balance from the previous bond issue.

#### **HOW MONEY HAS BEEN USED.**

The Highway Commission has used such moneys as have come to the state from federal aid sources in excess of the \$4,688,675 obligated in the \$40,000,000 bond act in making up deficits occasioned by increased building costs and heavier specifications, and in certain work of an imperative and emergency character, such as widening and thickening portions of highways, that had they not been protected would have been destroyed under traffic. It was necessary also to use some of this money to float bonds, with the alternative of involving the state in damage suits from contractors running far into the hundreds of thousands of dollars, at a period when contracts were under way and bonds suddenly became unsalable because of a low and rigid interest rate. However, the use of this money has been so safeguarded that despite increased building costs, heavier specifications, emergency work, and such unforeseen costs as floating bonds unmarketable at par, the funds of the Highway Commission will assure meeting every budget obligation.

#### **FLEXIBLE FUND NEEDED.**

It is the opinion of the Highway Commission that in the future federal aid funds should not be budgeted, but should be left to give some flexibility to highway financing.

While congress has definitely committed itself only to federal aid appropriations up to and including the year 1925, the United States Bureau of Public Roads estimates that the construction of highways included and accepted as a part of the federal aid system or as it is more generally termed the "seven per cent system" will take twenty years. It would seem that continuous federal aid can be expected as long at least as the accepted federal road system is in process of construction.

#### **FOREST HIGHWAY MONEYS.**

In addition to the so-called federal aid moneys, Congress has also appropriated moneys to aid in the construction of the main highways traversing or leading into the national forests. California has been allotted this year \$1,460,871 from this fund known as the Forest Highway Fund. This fund is in addition to the Forest Development Fund, intended for the development of roads and trails within the national forests.

#### **DIFFERENCES OVER POLICY.**

Some difference of opinion has developed relative to the expenditure of the forest highway funds in California, the Highway Commission refusing to approve projects outside of the state highway system. This



Plate XI. State Highway, Sonoma County, showing concrete shoulders and roadway ready for asphalt surface.

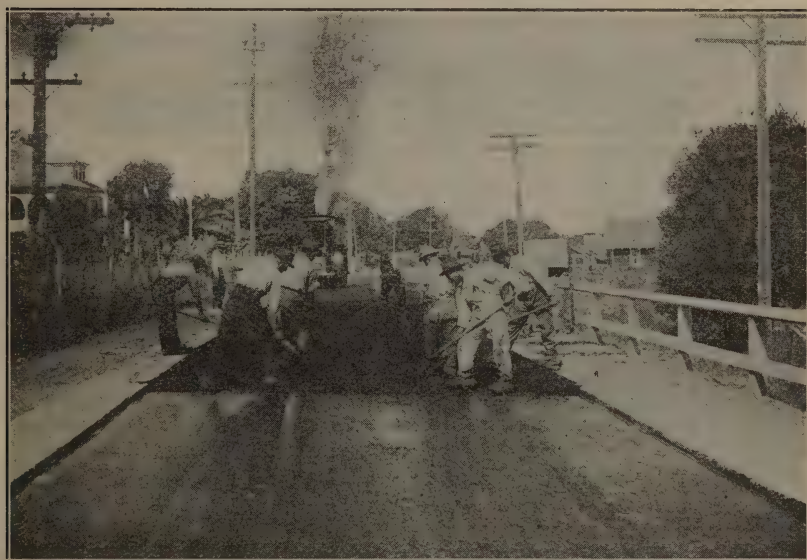


Plate XII. State Highway, Sonoma County, laying asphalt between concrete shoulders.

refusal is based upon the fact that there are 1000 miles of state highways within the national forests in California, and that these highways are inadequately financed.

The Commission does not believe that new road obligations should be assumed when funds are not available to fulfill obligations that already exist, particularly when the new obligations have regard to roads that the people of California have not considered of sufficient importance to include in the state highway system. In this stand, the Highway Commission has been supported by the United States Bureau of Public Roads.

The Highway Commission has regarded these forest moneys as a special fund created for a special purpose and not to be considered as a part of the budget.

#### **BUDGET OBLIGATIONS.**

In the expenditure of the \$40,000,000 bond funds, the Commission early adopted the policy that it would consider as binding the budget prepared by the proponents of the bond issue, and later ratified by the state legislature, although the budget itself was not made a part of the text of the bond issue. It was the opinion of the Commission that one road should not be robbed to build another. Strenuous efforts to force the abandonment of the budget were steadfastly resisted by the Commission. Despite the abnormal cost conditions, on November 1, 1922, there was a sufficient sum available to meet every budget obligation.

#### **SEVEN RECOMMENDATIONS.**

The California Highway Commission has reached certain definite conclusions relative to highway financing. These may be summarized as follows:

1. The demand for roads is so insistent that the public will not be content to await their construction on the slow process of a pay-as-you-go plan. Correlated with this is the demonstrable proposition that improved roads pay their own way with a handsome return on the investment, and hence an investment in good roads is a paying venture for the people of the State.
2. While another bond issue appears to be imperative, the users of the roads should be asked to bear a larger share of the highway burden than has been placed upon them in the past.
3. Future bond issues should not contemplate providing funds for the completion of the entire system. The public should realize that the completion of the state highway system is many years in the future and that as California grows, its road system must grow with it. Disappointment can only follow any bond issue which the people are asked to vote with the promise that it will be the last one.
4. The preferable method is to ascertain the amount of work that can be economically and efficiently undertaken by the California Highway Commission in any one year, and under normal building conditions. With this ascertained, the work should then be financed for a period of not less than five years.
5. Such a plan would require a rigid budgeting of the funds of a bond issue. Some financial flexibility is absolutely necessary in the conduct of the work. This can be secured if federal funds are left unbudgeted.
6. The gasoline tax and an increase and equalization of the motor vehicle fees offer a practical and fair method for imposing a larger share of highway costs upon highway users.
7. The legislature should definitely and rigidly refuse to designate roads as state highways unless at the same time finances for their improvement and maintenance are provided; nor should any roads be included in a bond issue unless a definite allotment for the construction of these roads is made.



## REGULATION OF TRAFFIC.

No less important but somewhat less perplexing than the question of highway finances is that of the traffic regulation on the roads.

It is the opinion of the Highway Commission that the present maximum weight of 30,000 pounds permitted upon the state highways should be decreased to a maximum permissible gross weight of 22,000 pounds. This latter weight will permit the operation of the five-ton truck and its load.

The Commission believes that the following load limits of some of the other states will justify the statement that in limiting loads to 22,000 pounds California will be imposing no unusual condition or undue hardship upon the trucking industry:

Vermont 12,500 pounds; Colorado 16,000 pounds; Maine 18,000 pounds; Alabama, Maryland, New Hampshire and Ohio 20,000 pounds; Oregon, Utah and West Virginia 22,000 pounds.

In fact, California, Michigan and New Jersey, each with a 30,000 pound limit, have the highest weight limits prescribed in the Nation. (*Engineering News Record* statistics, September, 1921.)

Experience has demonstrated that the mere passage of a regulatory law is useless unless machinery is set up for its enforcement. The Highway Commission recommends the establishment of an adequate force of state motor police to enforce traffic laws on state highways. It is the opinion of the Commission that such officers should operate under the direction of the Highway Commission for the reason that the body charged with the responsibility of maintaining highways should be vested also with power to adequately protect them.

### THE "MARYLAND PLAN."

The California Highway Commission would also recommend that there be written into the law of California by the next legislature the so-called "Maryland Plan."

This plan has been found the most effective method yet devised for stopping overloading, inasmuch as under it, the operator of a truck found with an overload can be forced to remove it before proceeding farther on the highway. Once forced to leave a portion of his load by the roadside, there to incur the risk of damage through the elements or loss by theft, and the further expense of sending a truck back for a small cargo, operators are careful to avoid future overloading.

It is the opinion of the Commission that the above recommendations with possibly amendments of a minor character will meet with the approval of the responsible element of the trucking industry. This element constitutes the great majority of those engaged in the industry. It is the outlaw operator who has no regard for anything but the profits promised on the one load that he is hauling who must be controlled in California.

### SPECIFIC RECOMMENDATIONS.

Recommendations for traffic regulation may be summarized as follows:



1. The maximum permissible weight on state highways should not exceed 22,000 pounds.
2. An adequate force of state motor police be authorized for the enforcement of traffic laws on state highways.
3. The above police to be under the authority of the State Highway Commission, the body responsible for the protection and maintenance of highways.
4. Where portable scales reveal that a truck is overloaded, traffic officers be authorized to demand the removal before the truck proceeds on the highway; the so-called Maryland plan.

## CONSTRUCTION PROBLEMS AND POLICIES.

In view of the fact that the past few years have constituted a transition period in California's highway history, it would indeed be strange if there had not been manifested a keen interest and criticism of types of road construction and engineering and administration policies.

The fact should not be forgotten that the highway transportation system of the state and nation is undergoing just such a change as the railroads experienced.

Under the traffic that they themselves created the railroads passed from a period of light construction to a period of heavy construction; from the 40 pound rail to 110 pound rail; from single track to the double track; from the C. P. Huntington engine, which today looks like a toy, to the giant Mallets.

### COMPARATIVE FIGURES.

In 1910 when the first state highway bond issue was voted in California the total registration of motor vehicles was 44,142 and in 1922 to date is in excess of 816,000. If figures were available for the two years in motor vehicle miles or in ton miles, the comparison would be even more astounding.

The problem before the Highway Commission was and has been to develop a type of road that would give a serviceable mileage to the state; that would take care of traffic increasing in an almost unbelievable manner; and that could be widened and thickened as the volume of traffic requires without the loss of the original investment.

The success with which this difficult problem was met constitutes a triumph of the engineering department of the California Highway Commission that has won for the department an enviable position in engineering councils the world over.

### OLD AND NEW ROADS.

Beginning with the slab fifteen feet wide and four inches thick, the concrete roads of California were progressively bettered as traffic increased. The minimum thickness was increased to five inches with greater thickness where subgrade conditions demanded it.

Steel reinforcement has been used in increasing quantities. Super-elevation has taken the place of the flat curve. Roads have been widened to the extent that finances permitted; the edge of the road, always a weak spot, has been thickened and strengthened.

The traffic has become so enormous now, however, that the Highway Commission desires to repeat its warning of four and two years ago, that the state must proceed to widen and in many places thicken its main highways. Unless approximately 1200 miles of main state highways are widened and thickened within the next five years, the loss through traffic impact and traffic congestion will be very great.

#### CAN DELAY NO LONGER.

As the Commission pointed out in its last biennial report this work should be carried on in advance of actual deterioration of the roadbed. Funds for this purpose were refused by the last legislature. Limited in funds the Highway Commission has exerted every effort to carry on this work where emergency conditions existed during the past two years. However, the work can not be carried on indefinitely unless funds for this special purpose are provided. Given these funds the loss to the state of its original investment will be very small. Denied them, the destruction of hundreds of miles of roads can be expected. Those in charge of financing the state highway system face a heavy responsibility in this matter, a responsibility that can not be avoided for another two years.

#### PLAN IS READY.

In this regard the Highway Commission, through its engineering department, has evolved a highly successful and economical plan for widening and thickening highways.

Where the old pavement base is still in fair condition, it is being widened to 20 feet by the addition of Portland cement concrete shoulders 2.5 feet wide, 7 to 8 inches thick, and surfaced with asphaltic concrete  $2\frac{1}{2}$  to 3 inches in thickness. Where the old base is badly cracked and has seriously deteriorated a complete new pavement not less than four inches in thickness is being constructed on top of the old base, making a total thickness of not less than eight inches.

The soundness of this plan can not be successfully attacked.

The Highway Commission has done all that it can do. The plan has been devised; its success has been demonstrated; the whole question is now one of funds. The responsibility rests with the legislature and the Governor to give the Highway Commission these funds.

#### VARIOUS ROAD TYPES.

While the prevailing type of road constructed in California has been of the cement concrete base type, the Highway Commission is strongly of the opinion that there is no one universal type of road.

The type of improvement to be selected for any road depends primarily upon subgrade conditions, the probable traffic to which the particular road will be subjected and the amount of money available for its construction.

The Highway Commission has in a large number of instances called for bids on alternate specifications of cement concrete and asphaltic concrete. In many instances asphaltic macadam has been laid. In other instances the improvement has consisted simply of grading and graveling roads.



Plate XIII. State Highway, Los Angeles County, slope paving.



Plate XIV. California State Highway Commission's road exhibit at State Fair, 1922.



It is the opinion of the Highway Commission that pavement should not be undertaken on mountain roads except under the most exceptional conditions until these roads have been widened to a minimum of 21 feet on fills and 18 feet in cuts. Even then the wisdom of paving a mountain road is doubtful unless it is found practically impossible to maintain the gravel surface under the traffic it is called upon to bear.

#### CONSTRUCTION PROBLEMS NOW DEFINED.

In the construction of highways the road builders of today enjoy a great advantage over the builders of the earlier period in that sufficient time has elapsed to develop the weak points in highways. Problems involved in construction are more clearly defined now than they were a few years ago.

A notable contribution toward better highways was the study of the California highway system by the United States Bureau of Public Roads in 1920. This study, which was the most intensive investigation of highways ever undertaken, developed that  $87\frac{1}{2}$  per cent of the paved highways of California were in good serviceable condition. Pavement constituting  $12\frac{1}{2}$  per cent of the entire mileage was designated under six classes varying from a condition where travel was somewhat impeded to one where the road was considered impassable. *The noteworthy fact was that of  $12\frac{1}{2}$  per cent, which constituted the impaired highway, 70 per cent was on adobe soil.*

#### BATTLING WITH THE ADOBE.

The problem of conquering the adobe is accordingly one of the big problems before the road builders of California as well as the builders of other states.

In conjunction with the United States Bureau of Public Roads the California Highway Commission has undertaken a large number of experiments dealing with the treatment of adobe subgrades. In some sections the subgrade has been treated with asphaltic oil below the concrete slab. In other places the adobe has been treated with lime. In still others gravel and sand have been used. On one section of the Rio Vista-Fairfield road, cement was broadcasted into the adobe subgrade. The success or failure of these various methods of treating adobe subgrades can not be foretold but must await the test of time and traffic.

An interesting development of the Pittsburg test road was the relative immunity of its subgrade from saturation both from rain and from flooded ditches. There the adobe subgrade was prepared in six-inch layers and subjected to heavy rolling. It is believed that this offers a suggestion for making the adobe subgrade more impervious to water than it has been in the past.

The treatment of adobe soil constitutes but one of many experiments that are in progress on California highways.

#### OTHER EXPERIMENTS.

Various sorts of asphalt pavement have been laid to see if a type could be developed which under actual road conditions would secure an increased degree of rigidity, thus lessening the corrugation difficulty.



These same experiments seek to ascertain some method of treating asphaltic surfaces to make them less susceptible to skidding.

Laboratory experiments have been carried on for several years to determine the resistance of asphaltic road materials to alkali. These experiments indicate that where alkali is active by reason of the presence of water, asphaltic roads are less susceptible to alkali damage than is cement concrete.

The Pittsburg tests demonstrated the changes in a concrete slab due to climatic conditions are greater than heretofore supposed. Near Fairfield the Highway Commission is laying a section with the so-called pre-cast slab type. These slabs are cast at a central station under uniform casting and curing conditions, and later transported by truck to the road and derricked into place. This process, if successful, will be invaluable for desert construction where water and materials are all inaccessible.

The Pittsburg tests also emphasized the fact known to road builders that impact is the chief factor in road destruction. The Highway Commission has grappled with the problem of reducing impact to a minimum by eliminating unevenness in the road as far as it is possible so to do.

Impact has been found particularly destructive at the edges of roads and at the junction between two slabs. By widening roads and by thickening the edge, the destructive effect of traffic blows on the edge can be and is being overcome. The method of lessening impact at the junction of slab, where unevenness of surface is difficult to prevent, is harder of solution. Experiments are now being conducted in tying slabs together by the use of steel dowels, extending from one section of highway into the adjoining slab.

Reference has already been made to the various types of roads constructed in California, which afford in construction costs and maintenance charges, a check upon the relative cost of the service they provide.

#### **CONVICT LABOR ON STATE HIGHWAYS.**

During the past two years, convict labor has been used on the state highways to the maximum extent that it has been possible so to do. In the early months of this period, the use of such labor was made particularly desirable by the shortage of free labor. It is the belief of the Commission, however, that even under normal labor conditions the value of convict work on highways to the state and to the convicts themselves is such that all available labor of this kind should be employed.

There are certain difficulties inherent in this work but these can be overcome when to firm control is added kindness of treatment and generous attention to physical comforts.

#### **COST AS COMPARED WITH FREE LABOR.**

With the resumption of normal cost conditions during the latter part of the biennium, the difference that had hitherto existed between the cost of free and convict labor on state highways has been materially reduced. During the period of 1919 and 1920, the cost of convict and free labor in the same part of the state averaged \$2.06 per day and \$5.50 per day, respectively. The average cost for 1921 and up to and



Plate XV. Showing method of bank protection adjacent to State Highway Bridge over the San Gabriel River in Los Angeles County.



Plate XVI. Bank protection to protect State Highway Bridge over San Gabriel River in Los Angeles County.

including October, 1922, showed the average daily cost of convict labor to be \$2.30 and of free labor \$4.50. In this connection, however, it should be remembered that convict labor is used in isolated and remote sections where free labor costs would run above the average.

The increase in the cost of convict labor in the latter period is accounted for by the fact that the convict camps were located in more remote places than in the earlier period, and the cost of taking in supplies was accordingly greater.

#### **EXCELLENT ROADS BUILT BY CONVICTS.**

The state is securing excellent roads from convict labor. Experience has shown convicts work best on original construction and that they are apt to lose interest if assigned to the more monotonous work of reshaping or widening a road already constructed. Accordingly, these men have been concentrated on sections where first construction is under way. A total of 132 miles of state highway has been built by convicts.

#### **SUCCESS AND SAFETY OF THE WORK.**

For obvious reasons, convict labor has been employed in remote mountain districts as the remoteness of the work increases the difficulty of escape and thus discourages such attempts.

Experience has also shown that civilian residents of the sections in which these men are employed have little to fear from the proximity of convict camps. In the past two years there have been 92 escapes from the convict camps. Of these escapes 60 men have been captured. Remembering that 1005 convicts have been employed on highways during this same period, the number of escapes is exceedingly small.

Equally important as the saving to the state by convict labor is the value of the work to the convicts themselves. This labor affords an opportunity for men convicted of crime to step gradually from prison to free life. The eagerness with which convicts seek this work and their general good behavior in camp reflects the worthwhileness of the work to the men.

#### **FACTORS THAT LIMIT CONVICT EMPLOYMENT.**

There are certain factors that limit the number of convicts that can be employed on state highways. These may be summarized as the need of the two state prisons for labor within their own walls; the number of prisoners who are physically fit for heavy manual labor; the prison records of the men as indicating the safety with which they can be allowed to come in contact with civilians; the ability of the penitentiaries to supply full crews for camps, as experience has shown that it is unwise to mix free and convict labor in one camp; and the amount of work in remote sections that the State Highway Commission can undertake.

In only one instance has there been evidence that convict labor on highways was depriving free labor of employment that it desired. In this instance a free labor camp was immediately organized.

The success of the use of convict labor has been made possible by the cooperation of the members of the State Board of Prison Directors,





Plate XVII. Pittsburg Test Highway, showing special highway built for testing purposes.



Plate XVIII. Pittsburg Test Highway, showing block markings for recording data.



James A. Johnston, warden of San Quentin State Prison, and J. J. Smith, warden at Folsom.

The Highway Commission believes that the policy of employing the maximum available convict labor in highway work should be continued, not alone because of its saving to the state, but also because of the saving in human values that constructive employment in an out-of-prison environment makes possible.

#### CONTRACT AND DAY LABOR JOBS.

In pursuance of its policy of letting all work wherever possible by contract, the Commission during the past two years has awarded contracts amounting to \$18,500,000. Day labor jobs undertaken during the same period aggregated \$4,700,000, and were undertaken only where special reasons existed for their construction by state forces.

A number of conferences have been held with the Contractors' Association, and as a result, agreement as to a number of disputed points relative to the conduct and supervision of the work have been amicably adjusted. The Commission wishes to express its appreciation of the fair and helping attitude of contractors generally toward the work; it has been the effort of the Commission and the members of the Department to cooperate with the contractors on the basis of mutual fairness and helpfulness.

#### THE PITTSBURG TEST ROAD.

The Highway Commission participated in a series of road tests instituted by the Columbia Steel Company at Pittsburg, California, to which reference has already been made. Without elaborating upon the value of technical information that these tests developed, it is sufficient to say that the tonnage carried on this test road developed beyond question that the highways built under California specifications afford a traffic service that makes the investment a most profitable one.

Once more it is proved that California's policy of building the roads to suit the traffic and without "over designing" them is the right plan, economically. The easy way would have been to have made the pavement slabs "over massive" ten years ago but it would have been a wasteful policy.

#### TESTS TO BE CONTINUED.

Through the courtesy of the Columbia Steel Works, it has been possible for the Highway Commission and the United States Bureau of Public Roads to obtain the use of the Pittsburg tract for further tests. In these new tests, different types of road sections will be installed.

These tests are of great value inasmuch as they afford road authorities opportunity to test out various theories concerning road construction, and to obtain "hurry-up" information, impossible of attainment if results had to be developed upon highways built for the use of ordinary pleasure and commercial traffic.



Plate XIX. Pittsburg Test Highway, showing loaded trucks.



Plate XX. Pittsburg Test Highway, showing 50-ton load.

## MAINTENANCE OF STATE HIGHWAYS.

No less important than the construction of highways is their maintenance. With the increasing mileage of improved highways, their increased age, and the enormous traffic they are called upon to bear, the problem of proper maintenance is one that calls for the best thought of both highway engineers and administrators.

Eternal vigilance is the price of good roads.

Quick perception of where repairs must be made and early repairs means not only a saving of roads but a saving of large sums in maintenance costs.

### MAINTENANCE SYSTEM.

The maintenance system of the California Highway Commission is based upon constant inspection. Each of the seven divisions of the state has maintenance and patrol men who are on constant duty. In addition to this, three assistant engineers, attached to headquarters, working out from headquarters and reporting directly to the chief engineer and through him to the California Highway Commission, report upon the condition of the highways. They render a detailed report upon the condition of every section of the road, and these reports in their original form are submitted and studied both by the engineering department at headquarters and by the members of the Commission. Where criticism is voiced, the report is sent to the division engineer and his views are obtained and submitted to the chief engineer and to the Commission. This system of inspection has proven very effective in maintaining the state highways in proper condition. The importance of a careful study of inspection reports can not be over emphasized.

### OLD COUNTY HIGHWAYS.

One of the biggest problems of maintenance has been the old oiled macadam roads, originally built by the counties, and taken over by the state. Many of these roads require reconstruction, but capital funds for such reconstruction have not been available. The result has been that the cost of maintenance has been excessive, and the condition of the roads at that far from satisfactory. With the reconstruction of these roads, one of the big maintenance problems of the state will have been solved.

The same is also true with roads constructed by the state which are showing signs of weakness under the present heavy traffic. Maintenance costs will run high on these roads until the widening and thickening operations already started are completed.

### PROTECTING BRIDGES AGAINST FLOODS.

A maintenance problem that assumed serious proportions during the winter of 1921-1922 was the protection of bridges against floods. Bank protection work hastily thrown in prevented the loss of a number of bridges in southern California. Apparently, bank protection work of a permanent nature will be necessary on a number of rivers in southern California and on the Salinas river in northern California.



### **MAINTENANCE OF SHADE TREES.**

The Pittsburg tests revealed that the paved surface of a road was subject to changes due to the heat of the sun to a greater extent than had hitherto been supposed. These tests explained the fact observed all over the state highway system that shade was a very effective agent in road maintenance. The planting of trees along the highways by communities has been made possible by the agreement of the Highway Commission to maintain these trees, and by the purchase of lands by the Highway Commission, on which the State Forestry Board is maintaining a state nursery. Viewed simply from the point of view of highway maintenance and without regard to the beautification of highways, the wisdom of the expenditure of maintenance money to secure better shaded highways is fully justified.

### **MISCELLANEOUS HIGHWAY MATTERS.**

While major matters concerning California's highway system have been discussed in some detail, the Commission desires to call attention to some further matters of importance in state highway affairs:

#### **GRADE CROSSINGS.**

Since the inception of its work the Highway Commission has thus far eliminated 163 grade crossings with railroads. There are now in California over 250 grade crossings on the state highway system, exclusive of industrial spur tracks. Traffic on the highways has reached the point where the complete elimination of grade crossings seems desirable. By the installation of automatic warning lights, the Highway Commission has attempted to reduce the hazard of these crossings. It is true that an overwhelming proportion of accidents are due to the carelessness of the drivers, but the protection of drivers against themselves and the protection of the persons who may be riding with careless drivers apparently necessitates the early separation of grade crossings. Funds to carry on this work should be specifically provided either by legislative enactment or by the inclusion of the needed amount in a bond issue.

#### **SURPLUS WAR MATERIALS AND THEIR USE.**

During the biennium, the California Highway Commission was apportioned much surplus war material by the federal government. This material is of varying value and usefulness. Its greatest value lies in the trucks received. Thus far a total of 884 trucks have been apportioned to California by the War Department.

The policy of the Commission has been to share the benefits of this war material with the counties as far as it is possible to do so without depriving the state of equipment that it needs.

Under the law, the Commission can not divest itself of the title to this equipment. By leasing trucks to counties at a nominal rental of \$1.00 per year, however, the law has been complied with and trucks put in use that otherwise would have remained idle in the Commission yard. Thus far, three trucks have been allotted to each county in the state.

A further distribution to the counties is proposed with the arrival of another assignment of government trucks.



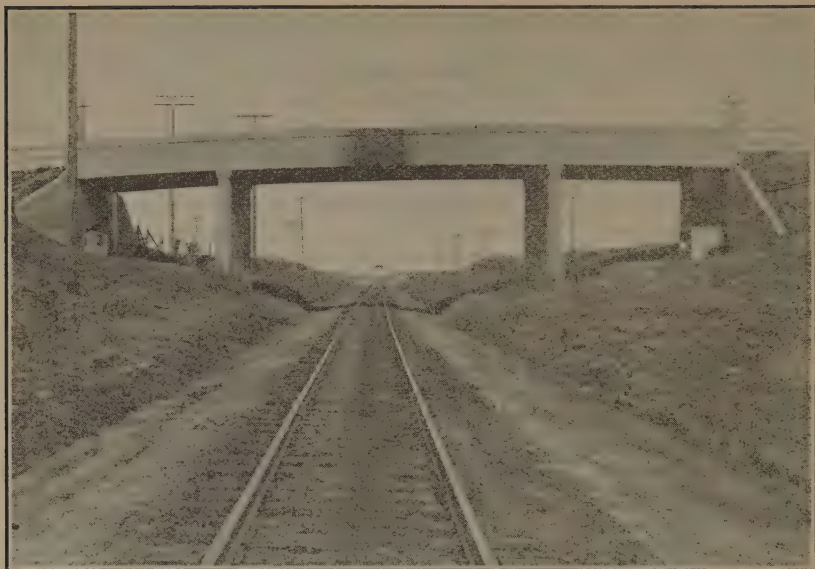


Plate XXI. State Highway, Stanislaus County, showing Riverbank overhead crossing, Atchison, Topeka and Santa Fe Railway.

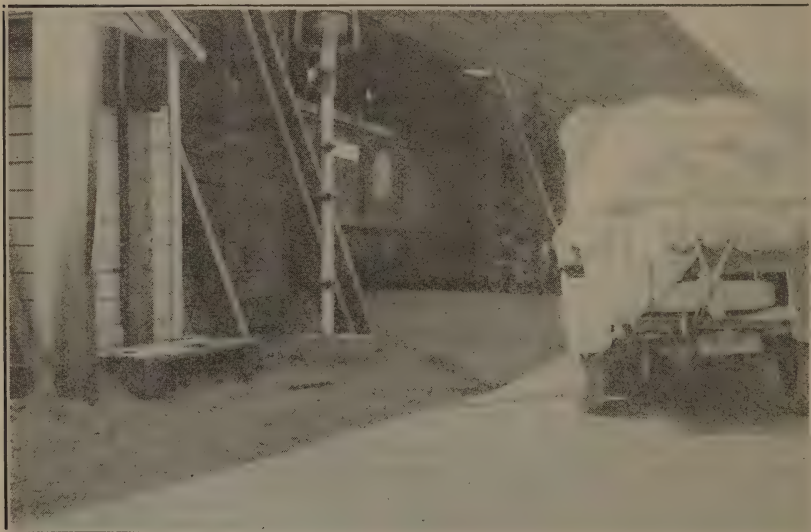


Plate XXII. State Highway, Placer County, Auburn-Verdi road grade crossing through snow sheds, Southern Pacific Railroad.

### HIGHWAY BEAUTIFICATION.

The plan devised by the Highway Commission three years ago for the beautification of highways by systematic and properly designed tree planting is progressing in an exceedingly satisfactory manner. Many communities have undertaken the beautification of the highways in their vicinity. The Highway Commission desires to express its appreciation of the cooperation extended to it by the State Board of Forestry and by the Highway Tree Planting Committee.

### ROADSIDE ADVERTISING.

The Commission during the past two years has consistently adhered to its policy of refusing to allow the state highways to be used for advertising purposes. While successful in keeping the highway right of way free from advertising signs, the work of the Commission has been nullified in many instances by adjoining property owners who permit the erection of advertising signs immediately across the line from the highway. It would seem that the creation of a public sentiment against the nightmare of futuristic advertising that litters up the landscape and renders unsightly the vicinity of state and county highways might be a matter worthy of the attention of newspapers, women's clubs and civic bodies generally.

### TRAFFIC CENSUS.

The California Highway Commission is now engaged with the United States Bureau of Public Roads in a complete traffic census of the state highway system, the cost of which will be equally shared. This study should give an approximately correct estimate of the volume of traffic on the state highways, the tonnage the highways carry, the peaks and the depressions in the traffic load. Its value in estimating the service to which a road will be subjected will be immediately apparent to all students of highway matters. Most counties having improved systems are cooperating in this work by taking a traffic census on important county thoroughfares.

### THE SEVEN PER CENT SYSTEM.

In accordance with the Federal Highway Act approved on November 9, 1921, the California Highway Commission has indicated to the United States Bureau of Public Roads the system of roads to which it will confine federal funds. Under the law, the use of federal aid moneys is confined to seven per cent of total road mileage in any state. This road mileage in California from the best figures obtainable totals approximately 70,000. This state is accordingly confined to 4900 miles or 1500 miles less than the mileage in the state highway system.

Although the federal highway act does not require that the roads contained in the seven per cent system be a part of the state highway system, the California Highway Commission has designated no roads outside of the present highway system as a part of this seven per cent system, except where the United States Bureau of Public Roads requested the inclusion of short stretches of roads needed to establish a connection with the seven per cent systems of Oregon and Nevada.



Plate XXIII. Luther Burbank planting first tree on the State Highway between Santa Rosa and Petaluma, March, 1921.



These connections were made a part of the federal system, but with a very definite understanding that no money would be expended upon them by the Highway Commission until they were made a part of the state highway system either through act of the legislature or by direct enactment of the people.

#### THE PROBLEM OF THE SMALL MUNICIPALITY.

There is an insistent demand from a number of the smaller and poorer municipalities of the state for aid in financing the highways through their limits. Nearly all of these municipalities have shown a willingness to help themselves as far as they can, but the problem of building a highway through their city is often beyond their means. The lack of sufficient valuation of property abutting on the highway prevents the improvement being charged to such property. Where the matter was acute, the Highway Commission has assisted in the improvement, generally by constructing the portion of the road in the less improved sections of the city, leaving it to the city to construct in the portion where there is a larger improvement. There are, however, a number of other municipalities which have asked for such assistance, and where some measure of state assistance is warranted. Lack of available funds has prevented such cooperation.

As a general rule it is the belief of the Commission that the cities should be left as in the past to improve the streets through the city designated as a part of the state highway system. The fact that the city authorities must surrender jurisdiction over a street that the Highway Commission improves makes it unwise for the State Highway Commission to invade the limits of an incorporated town. Again experience has shown that insistence by the Highway Commission upon an improvement of a city street in a number of instances has launched municipalities upon a much needed campaign of general street betterment. But there are exceptions to this rule. Small municipalities which for one reason or another have included large areas in their incorporated limits, and which find themselves with insufficient taxable property to improve the highway through their limits must have help. It can come from no other source but the state.

#### CAMPING SITES.

The large and increasing volume of recreational travel on the state highways is bringing to the front a new problem, that of ways and means of caring for this travel. The problem of sanitation is in many places already perplexing authorities. With this large travel the fire hazard to forest and field has also increased.

Apparently the state and forestry officials will be forced eventually to concentrate camping on the more largely traveled routes at selected camp sites.

As far as it has been able to do so without expenditure of funds, the Commission has attempted to anticipate this need, and to provide sites that later may be utilized for camping. In this same line of endeavor it has attempted to prevent the destruction of the natural forest along the state highways, and has secured and assisted in securing for the state, places of particular interest along the highways. As an instance of



this, through the right of way agreement with the Albion Lumber Company and the Pacific Coast Redwood Company, a considerable acreage of beautiful forest ideally adapted to camping has been secured on the Navarro highway in Mendocino County.

By a very slight change in routing, the Highway Commission was also able to secure ownership of the Kelly Hot Springs in Modoc County. These boiling sulphur springs will always prove an attractive feature to travel in northeastern California, and their full enjoyment is now assured to the traveling public for all time.

The Highway Commission has worked hand in hand with the Save-the-Redwoods-League in the preservation of redwoods along the state highways.

By insistence that the natural forest along the highway in the section from Trinidad to Orick north of Eureka be preserved, the Highway Commission was deeded a right of way 80 to 100 feet wide with a fee to all the timber. This grant was generously made by the Lagoon Lumber Company.

Conferences and discussions have been had with United States Forestry officials of the Western Division, in an effort to work out some cooperative plan for installing camp sites on state highways in national forests. The importance of this work is mutually recognized, but insufficient funds upon both the part of the Highway Commission and the Forestry Service has prevented suggested plans from taking definite shape.

In this same connection the Commission is of the opinion that comfort stations should be erected particularly along desert roads.

#### **AN INTERNATIONAL ROAD.**

One of the big routing problems on the California highway system is that through the shifting sand hills between Yuma and Holtville. This section is now traversed by a plank road. The final solution of the problem appears to be to locate the road south of and away from these shifting sand dunes. To do this, however, would require that for a distance of approximately 15 miles, the state highway be built in Mexican territory.

Through United States Senator Hiram W. Johnson the Highway Commission has taken up with the State Department the matter of establishing a neutral zone for highway purposes. While giving encouragement to the idea that such a zone may eventually be established, the State Department is of the opinion that the matter must lie dormant until governmental conditions in Mexico become more settled.

#### **THE SNOW PROBLEM.**

Increasing travel upon the roads requires that they be kept open either through the winter or for a much longer period than has hitherto been the practice. Following the heavy snowfall which closed the Ridge Route last winter, arrangements were made by the California Highway Commission to keep snow plows available there to prevent the necessity of again closing the road because of snow.

In the Sacramento River Canyon the heavy travel has occasioned a demand for an all-year route. A snow plow accordingly will be kept in service there.



Plate XXIV. State Highway, Los Angeles County, showing snow conditions on Ridge Route.



Plate XXV. State Highway, Los Angeles County, showing difficulties of motoring through snow on Ridge Route.

It would seem that the time is not far distant when mountain roads will be kept open as long as there is sufficient travel to justify the expense.

This development is of further importance inasmuch as if the highway snow plow proves a success, mountain roads may be routed over higher elevations, at a saving of millions of dollars in construction costs.

#### ALEXANDER SUIT.

Following the decision of the Highway Commission locating the route for the portion of the state highway between Long Beach and Seal Beach, Scott Alexander, a property owner in that vicinity, brought a suit in the Superior Court of Los Angeles County, alleging that the route chosen by the Commission contravened the requirements of the state highway bond measure. The Commission answered that it deemed the location selected by it to be the most practical and economical. The court held that the choosing of the route rested entirely within the discretion of the Commission, that it would not interfere unless bad faith was shown and that plaintiff failed to establish that. Accordingly, the court ordered a judgment of nonsuit against Mr. Alexander.

#### BOND DISCOUNT LITIGATION.

Action was brought in the United States District Court at Los Angeles, by S. H. Mitchell, a resident of Arizona, and directed against Governor Stephens, members of the Board of Control and Commissioners Darlington and Whitmore, having as its ostensible purpose to force these officials and others to return to the state approximately \$225,000 of federal aid money expended in making up discounts on bonds sold at a time when bonds were unsalable by reason of a low interest rate.

The bonds were sold upon a plan pronounced legal by Attorney General Webb, and sanctioned by State Treasurer Friend W. Richardson and State Controller John S. Chambers.

When the bond market collapsed in the fall of 1920, the State Highway Commission had a large number of contracts under way. Either highway work had to be stopped or contractors had to be paid. If the work was stopped, contractors openly stated that damage suits would be filed running into huge sums. The action of the state authorities in preventing this disaster was both good business and good sense. Recognition of this fact was given by the legislature of 1921 which amended the law to allow the state to sell bonds at their market value.

#### IN APPRECIATION.

The Highway Commission desires to express its appreciation of the helpful counsel which it has uniformly received from Governor William D. Stephens. His interest in highways has been as broad as California itself and has included every county and every community in the state. Words but perfunctorily express the interest that he has shown in the work, an interest entirely divorced from any consideration other than the proper progress of the work.



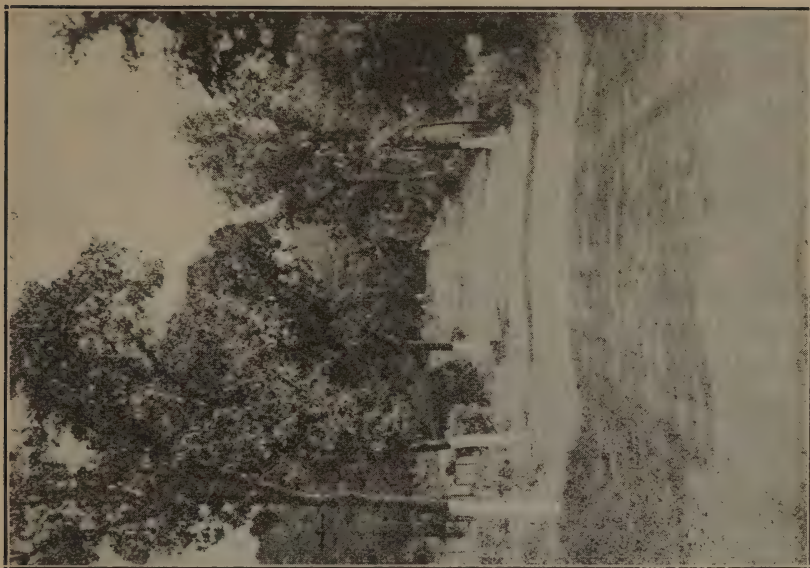


Plate XXVII. State Highway, Mendocino County, showing gravel surfaced roadway.

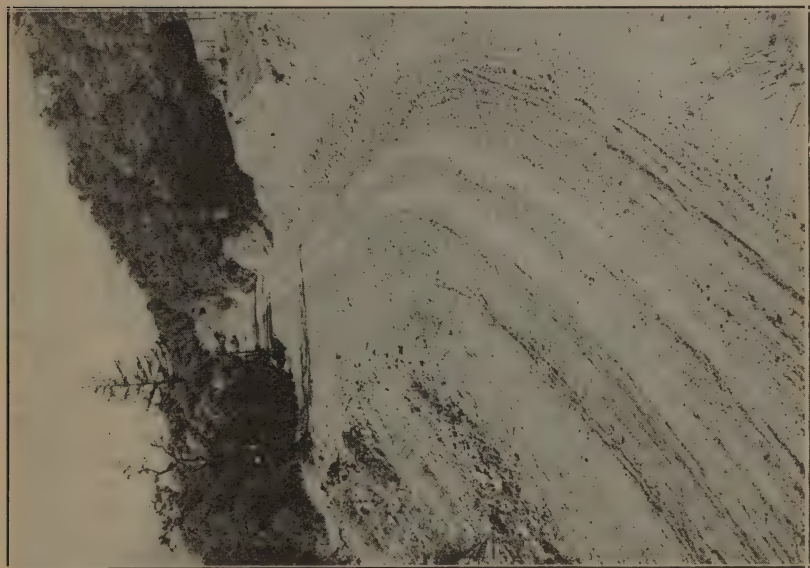


Plate XXVI. State Highway, Mendocino County, showing graded roadway.



The Commission also desires to express its gratitude for the loyal and able support given it by A. B. Fletcher, chief engineer of the Highway Commission, and the members of the engineering and accounting departments; to C. C. Carleton, attorney for the Commission, and the members of the legal department; and to Roy A. Murray, secretary to the Commission, his predecessor John F. Galvin, and the employees of the secretary's office.

The Commission also desires to express its appreciation of the support given to it by the supervisors of California both through their associations and individually. The supervisors were chief factors in blocking the efforts of a powerful lobby to enact legislation at the 1921 session of the legislature that would have proven most inimical to the road interests of California. The keen interest of supervisors in highway affairs and their accurate knowledge of local conditions has made the cooperation of these officials of great help to the California Highway Commission. The same helpful cooperation has been extended by the county engineers.

The Commission feels that California can rightly take pride in the high personnel of the men and women employed in these various departments.

Grateful appreciation is also extended for the cooperation and assistance rendered California by the United States Bureau of Public Roads, both through Thos. H. MacDonald, chief of the bureau, and through L. I. Hewes, deputy chief engineer, and C. H. Sweetser, district engineer.

As far as the California highway system is concerned, and the manner in which the highway work is conducted, the Commission closes this report with the following excerpt from a public statement made by Governor William D. Stephens:

"We must not forget that in ten years time California has created a road system that challenged and received the admiration of the world. We should not be forgetful of the fact that this system of highways has been so laid out that it serves today not only the two large cities of the state but in addition 66 per cent of the population of California, not including San Francisco and Los Angeles, are directly served by state highways. We should not be unmindful of the economic value of these highways, and should appreciate the importance of the economic service of these roads, a service estimated by the Bureau of Public Roads at \$20,000,000 in 1920 on a total expenditure of \$42,000,000. Nor should we be forgetful of the fact that California's highway system, involving as it does the expenditures of many millions of dollars, has been constructed without a breath of scandal or a suspicion of graft. The highways of California are today making the lives of our people infinitely more happy, and are making our state the playground of the nation.

I strongly feel that the good road forces of the state should join hands and in the words of former Secretary of Agriculture Meredith in transmitting the report of the United States Bureau of Public Roads on the California highway system, this state should 'continue the program of highway development upon which such splendid advancement has already been made.'"

#### CALIFORNIA HIGHWAY COMMISSION.

N. D. DARLINGTON, Chairman.

CHAS. A. WHITMORE.

GEORGE C. MANSFIELD.

## APPENDIX A.

REPORT OF STATE HIGHWAY ENGINEER TO  
CALIFORNIA HIGHWAY COMMISSION.

November 1, 1922.

*To the CALIFORNIA HIGHWAY COMMISSION,  
Sacramento, California.*

## INTRODUCTORY.

GENTLEMEN: As in the last biennial report, a series of appendices has been prepared for inclusion in this report, compiled chiefly by the several department heads at the headquarters office, which cover completely the varied activities of the Commission's work since June 30, 1920.

Unless otherwise explained, the statistics in all of the appendices relate only to the biennial period ending June 30, 1922.

The outstanding event in state highway activities during the biennial period in 1921-1922 was the adoption by the people of the State of California at the general election held November, 1920, of a constitutional amendment permitting a flexibility of interest rate in the \$40,000,000 bonds provided by the constitutional amendment adopted at the special election of July 1, 1919, such rate at no time, however, to exceed 6 per cent per annum.

This has enabled the State Highway Finance Board to fix from time to time a rate of interest for blocks of bonds placed on the market which accorded with the current interest rates. The bonds were thus made salable without difficulty.

During the last biennium, therefore, state highway work has proceeded in a continuous and systematic manner, and in such measure as the Commission, after consideration of prevalent costs of labor and material, has deemed prudent.

These bond sales, supplemented by moneys received from the United States government in reimbursement to the state on federal aid projects and by contributions from counties to finance the construction of certain county bridges, have enabled the Commission to carry on state highway construction during the years 1921-1922 in much greater volume than in any other biennium since the Commission was organized.

On June 30, 1922, the total expenditures from the state highway fund amounted to \$51,589,127.89, and of this amount \$16,590,331.38 was paid out after June 30, 1920.<sup>a</sup>

Likewise the total expenditures from the motor vehicle fund amounted to \$11,902,862.76, of which \$6,122,311.84 was disbursed between the dates of June 30, 1920, and June 30, 1922.<sup>a</sup>

<sup>a</sup>For detailed account of this disbursement see Appendix E.





MILEAGE OF STATE HIGHWAYS UNDER MAINTENANCE BY THE CALIFORNIA HIGHWAY COMMISSION, JUNE 30, 1922.

Mileage of Bond Issue Roads Constructed or Improved by the California Highway Commission.	Miles	Div. I	Div. II	Div. III	Div. IV	Div. V	Div. VI	Div. VII
Earth (Oiled)	378.89	48.09	.63.22	126.38		8.92	92.54	39.24
Gravel Surface	11.15	164.01	195.11	20.00	15.05	1.02	9.96	1.19
Asphalt Macadam	601.03	7.73	17.64	18.50		1.89	5.84	
Topeka on Macadam	64.12				16.44		18.36	
Portland Cement Concrete (Plain)	16.44							
Portland Cement Concrete (with oiled surface)	996.06	24.90	88.66	206.64	134.88	177.21	132.51	231.26
Topeka Surface on Portland Cement Concrete	570.61	4.06	3.23	139.60	55.94	76.28	135.65	155.84
Asphalt Concrete on Portland Cement Concrete	93.37			14.60	49.91	5.81	6.93	16.12
Asphalt Concrete (Base and Surface)	14.67				10.04			4.63
Bridges	.91	.72		3.38				.91
Plank Road	4.13							.03
	5.36							5.36
Total	2556.74	249.51	367.86	529.60	282.26	271.13	401.80	454.58
Mileage of Bond Issue Roads taken over but not rebuilt (Includes County Built Roads)								
Gravel	4.41				4.41			
Asphalt Macadam	166.57			94.42	5.42			
Portland Cement Concrete (Plain)	15.00					9.72		57.01
Portland Cement Concrete (with oiled surface)	16.76			.45				15.00
Asphalt Concrete (Base and Surface)	13.94			.68	2.67	10.59		16.31
Bridges	.53			.83				
Total	217.21			96.08	12.50	20.31		88.32
Special Legislative Act Roads Under Maintenance, but not improved under Bond Issues (not including Mother Lode Highway)	807.68		55.00	597.52	23.87	3.09	79.00	49.20
Built by U. S. Government (Taken over for maintenance)	12.93		12.93					
GRAND TOTAL	3594.56	249.51	435.79	1223.20	318.63	294.53	480.80	592.10

The foregoing figures do not include unaccepted contracts incomplete on June 30, 1922, at which time the following mileages of road were under contract let and in progress:

**State Highway Under Construction and In Progress, June 30, 1922.**

	Miles
Portland cement concrete base.....	193.08
Portland cement concrete base, second story.....	12.38
Asphalt macadam.....	97.21
Asphalt concrete pavement.....	31.73
Asphalt concrete surface on concrete base.....	89.52
Gravel surface roads.....	157.68
Graded roads.....	454.00
Portland cement concrete shoulders.....	27.49
<b>Total .....</b>	<b>1,063.09</b>

The following table shows the total quantities of grading and pavement dealt with since the beginning of the work:

	1912-1916 (incl.)	1917-1918	1919-1920*	1921-1922*	Totals
Grading, cubic yards.....	6,750,000	2,339,000	1,579,800	4,566,800	15,235,600
Concrete base and concrete shoulders, cubic yards.....	882,300	252,900	165,900	423,700	1,724,800
Asphalt concrete base and top, tons .....				82,800	82,800
Asphalt concrete surface and Topeka surface, square yards..	477,200	31,700	130,200	1,060,300	1,699,400
Asphalt macadam, square yards..	233,600		196,100	689,200	1,118,900

\*Quantities to June 30, 1920, and June 30, 1922.

**WORK TO BE DONE.**

As nearly as can be ascertained, in the absence of many miles of surveys not yet made, the state highway system (bond issue roads only) includes a total of about 5560 miles. As already shown, work has been completed or is now under construction by the combined efforts of the state and the counties on 3136.05 miles of the system, leaving on June 30, 1922, 2423.95 miles on which no work has been done to date. These roads or sections of routes are shown below. The sections may be identified on the map accompanying this report, marked "Appendix R."

## Portions of System Upon Which No Work Has Been Done, June 30, 1922.

County	Route	Section	Termini	Miles
Mendocino	1	B	Hopland to 2½ miles north	2.6
Humboldt	1	G	Fortuna to Loleta	3.9
Humboldt	1	I	Arcata to Mad River	4.0
Humboldt	1	J	Station 490+00 to 655+00 across Big Lagoon	3.0
Humboldt	1	K	Orick to Del Norte County line	14.7
Del Norte	1	A	Humboldt County line to Wilson Creek	13.8
Del Norte	1	CDE	Crescent City to Oregon line	43.0
Tehama	3	D	Los Molinos to Red Bluff	1.0
Siskiyou	3	B	Gazelle to Yreka	17.6
Sacramento	4	A	Galt to southerly boundary	1.9
Alameda	5	B	Castro Valley road to Hayward	0.5
Yolo	6	C	Sacramento River to end of paving West Sacramento	0.6
Los Angeles	9	B	La Canada to Pasadena	3.5*
Monterey	10	B-C	Long Valley road to easterly boundary	17.5
Fresno	10	ABC	Monterey County line to Coalinga	22.2
Kings	10	C	1 mile north of Lemoore to Hanford	9.4
Tulare	10	CDE	Visalia to Three Rivers	27.1*
El Dorado	11	D-E	Placerville to Sportsman Hall	7.4
Imperial	12	A	Westerly boundary to Myers Creek	5.7
Lake	15	B-C	Upper Lake to Colusa County line	32.6
Colusa	15	BCDE	Lake County line to Williams	34.4
Sutter	15	A	Meridian to Sutter City	8.1
Yuba	15	A-B	Marysville to easterly boundary	81.6
Nevada	15		Yuba County line to Placer County line	
Placer	15		Nevada County line to Route 37 near Cisco	
Mariposa	18	EFG	Briceburg to El Portal	16.7
Shasta	20	A	Trinity County line to Tower House	8.5
Trinity	20	A	2 miles south of Weaverville to Weaverville	2.5
Trinity	20	B	Shasta County line to Tom Long Gulch	11.0
Trinity	20	C	Burnt Ranch to Humboldt County line	12.0§
Trinity	20	F	Helena to Douglas City	21.0
Humboldt	20	A-B	Arcata to Redwood Creek	25.0
Butte	21	B-C	Oroville to Plumas County line	37.0
Plumas	21	ABC	Butte County line to Quincy	43.0
Santa Clara	22	A	Junction Route 32 at San Felipe to San Benito County line	0.6
San Benito	22	B	Santa Clara County line to Hollister	7.5
Los Angeles	23	F	Palmdale to Lancaster	7.9
Kern	23	BCDEFG	Mojave to Inyo County line	57.8
Inyo	23	GHIJKLM	Kern County line to Independence	74.0
Inyo	23	C	Fish Springs School to S.E. cor. S. 33, T. 8 S., R. 33 E.	11.7
Mono	23	D-E	Magee Creek to Deadman Creek	16.9
Mono	23	I	Dogtown to Bridgeport	6.6
San Joaquin	24	B	Lodi to Clements	12.3*
San Bernardino	26	A-B	San Bernardino to 0.29 miles north southerly boundary	12.1*
Riverside	26	B	Beaumont to Banning	3.0*
Imperial	26	AHG	3.2 miles south of Trifolium Canal to Imperial	21.1
Imperial	27	C-D	El Centro to East High Line Canal	15.8
Imperial	27	A	New County Well to County Well	9.4
Imperial	27	B	Through Yuma Indian Reservation	8.2
Shasta	28	A	Redding to 2.3 miles south of Ingot	25.7
Shasta	28	D-E	Burney to Lassen County line	28.5
Lassen	28	A-B	Shasta County line to Modoc County line	30.0
Modoc	28	A	Lassen County line to Adin Summit	13.0
Tehama	29	A	Red Bluff to Paynes Creek	22.0

\*Improved county road.

§Built by Forest Service.

County	Route	Section	Termini	Miles
Tehama	-----29	B	Paynes Creek to eleven miles east--	11.0#
Plumas	-----29	A	Chester Grade to Lassen County line--	9.0
Lassen	-----29	A	Plumas County line to Coppervale--	9.0
Lassen	-----29	CDE	Johnstonville to Nevada State line--	49.0
San Bernardino	---31	DEF	Victorville to Barstow--	36.5
Santa Clara	---32	A	Gilroy to San Felipe--	9.9
Madera	---32	A	Merced County line to Route 4 near Califa	15.7
Kern	-----33	A	San Luis Obispo County line to Junction pumping station--	15.5
Kern	-----33	C	Hart Station to Wasco--	19.0*
Kern	-----33	D	Wasco to Famosa	7.5
Sacramento	---34	B	Route 4 near Arnold to Clay--	9.3‡
Placer	---37	ABCDEFGH	Nevada County line (Auburn to Summit)	53.2
Nevada	-----37	ABCDE	Placer County line to Sierra County line	31.6
Sierra	-----37	A	Nevada County line to Nevada State line	12.5
Placer	-----38	B-C	Tahoe City to Nevada County line--	14.0
Nevada	-----38	A	Placer County line to Route 37 at Truckee	0.8
Fresno	-----41	A-B	General Grant National Park to Kings River Canyon--	14.5
Fresno	-----41	C	Lockwood Creek to Boulder Creek--	6.0
San Bernardino	---43		Deep Creek to Metcalf Creek--	14.0
Del Norte	---46	A	Route 1 near mouth of Klamath River to Humboldt County line--	9.0
Humboldt	---46	ABC	Del Norte County line to Siskiyou County line	53.0
Siskiyou	---46	A	Humboldt County line to Happy Camp	50.0#
Glenn	-----47	A	Orland to Butte County line--	10.3
Butte	-----47	A	2½ miles N.W. of Chico to Chico--	2.5
Mendocino	---48	ABC	McDonalds to Flynn Creek--	41.0
Lake	-----49	A	Napa County line to Lower Lake--	21.5
Napa	-----49	A	Calistoga to Lake County line--	10.7
Yolo	-----50	A	Rumsey to Lake County line--	10.6
Lake	-----50	A	Yolo County line to Lower Lake--	15.0
Sonoma	-----51	B	Beltane to Shellville--	12.5
Marin	-----52	A	Alto to 0.3 mile easterly--	0.3
Marin	-----52	A	Belvedere Crossing to Tiburon--	1.7
Solano	-----53	A	Fairfield to Denverton--	8.9
Amador	-----54	A	County line near Michigan Bar to Drytown	10.7
San Mateo	---55	ABCD	Sneath road to Santa Clara County line	33.1
San Mateo	-----55	E	San Mateo County line to common corner to San Mateo, Santa Clara and Santa Cruz counties--	3.7
Santa Clara	-----55	A-B	Common corner to San Mateo, Santa Clara and Santa Cruz counties to Route 5 near Glenwood--	17.8
Santa Cruz	-----55		Carmel to Monterey County line--	82.2
Monterey	---56	ABCDEFGH	San Simeon to 6 miles north--	6.2
San Luis Obispo	---56	A	Buckhorn Creek to 2nd crossing Cuyama River	16.3
Santa Barbara	---57	B	2nd crossing Cuyama River to 3rd crossing Cuyama River--	12.8
San Luis Obispo	---57	C	3rd crossing Cuyama River to 4th crossing Cuyama River--	15.6
Santa Barbara	---57	C	4th crossing Cuyama River to Kern County line	9.8
Kern	-----57	A	Westerly boundary to Maricopa--	11.05
Kern	-----57	BCD	Maricopa to Bakersfield	35.3*
Kern	-----57	EFGHIJKL	Bakersfield to Freeman (via Walker's Pass)	86.9
Kern	-----58	ABC	Mojave to San Bernardino County line	34.7

#Under construction by Forest Service.

‡Partially improved county road.

\*Improved county road.



County	Route	Section	Termini	Miles
San Bernardino	58		Kern County line to Needles (via Barstow) -----	201.0
Los Angeles	59		Lancaster to Baileys -----	34.0
Ventura	60	A	Oxnard to Hueneme road -----	8.6*
Ventura	60	A	Hueneme Road to Point Mugu -----	4.0
Ventura	60	A	Big Sycamore Creek to Los Angeles County line -----	4.0
Los Angeles	60	A	Ventura County line to easterly boundary Malibo Ranch -----	19.4
Los Angeles	60	CDE	Santa Monica to Orange County line --	49.8
Orange	60	ABC	Los Angeles County line to San Juan Capistrano -----	26.5†
Los Angeles	61		La Canada to Mount Wilson road (via Arroyo Seco) -----	25.0
Los Angeles	62		Azusa to Pine Flats in San Gabriel Canyon -----	28.0
Inyo	63	ABC	Big Pine to Mono County line -----	38.6
Mono	63	A	Inyo County line to Oasis -----	2.0
Riverside	64		Mecca to Blythe -----	100.0
Total -----				2423.95

\*Improved County Road.

†6.9 miles in incorporated cities.

Taking certain significant periods into consideration, namely, the pre-war years, the years of the war, and those since the armistice, brings out some interesting facts as shown by the figures below:

Average Contract Prices, <sup>5</sup>1912-1916 (Inclusive).

Year	Grading <sup>1</sup> (per cu. yd.)	Concrete, including all materials (per cu. yd.)	Sand, delivered (per ton)	Broken stone and gravel, delivered (per ton)	Cement, delivered (per bbl.)	Concrete, <sup>2</sup> exclusive of materials (per cu. yd.)
1912-----	\$0 39	\$5 82	----- <sup>4</sup>	----- <sup>4</sup>	\$1 61	----- <sup>4</sup>
1913-----	0 46	5 91	\$0 56	\$0 58	1 65	\$2 56
1914-----	0 51	6 75	0 54	0 85	1 70	3 03
1915-----	0 45	6 26	0 58	0 76	1 74	2 84
1916-----	0 37	6 37	0 60	0 76	1 80	2 90
Average <sup>5</sup> -----	\$0 49	\$6 35	\$0 56	\$0 78	\$1 70	\$2 92

Average Contract Prices, <sup>5</sup>1917 and 1918.

Year	Grading <sup>1</sup> (per cu. yd.)	Concrete, including all materials (per cu. yd.)	Sand, delivered (per ton)	Broken stone and gravel, delivered (per ton)	Cement, delivered (per bbl.)	Concrete, <sup>2</sup> exclusive of materials (per cu. yd.)
1917-----	\$0 73	\$8 03	\$0 66	\$0 86	\$1 80	\$4 17
1918-----	0 78	10 51	1 05	1 28	2 20	5 53
Average <sup>5</sup> -----	\$0 74	\$8 67	\$0 76	\$0 96	\$1 90	\$4 51

Average Contract Prices, <sup>5</sup>1919 and 1920 (to June 30, 1920).

Year	Grading <sup>1</sup> (per cu. yd.)	Concrete, including all materials (per cu. yd.)	Sand, delivered (per ton)	Broken stone and gravel, delivered (per ton)	Cement, delivered (per bbl.)	Concrete, <sup>2</sup> exclusive of materials (per cu. yd.)
1919-----	\$0 96	\$13 08	\$1 10	\$1 33	\$2 64	\$6 37
1920-----	1 10	16 25	1 23	1 41	2 68	7 64
Average <sup>5</sup> -----	\$1 01	\$14 82	\$1 17	\$1 37	\$2 66	\$7 00

Average Contract Prices, <sup>5</sup>1921 and 1922.

(Costs are from June 30, 1920, to June 30, 1921, and June 30, 1921, to June 30, 1922.)

Year	Grading <sup>1</sup> (per cu. yd.)	Concrete, including all materials (per cu. yd.)	Sand, delivered (per ton)	Broken stone and gravel, delivered (per ton)	Cement, delivered (per bbl.)	Concrete, <sup>2</sup> exclusive of materials (per cu. yd.)
1921-----	\$0 94	\$17 34	\$1 74	\$2 09	\$3 39	\$7 97½
1922-----	0 71	14 29	1 47	1 77	3 10	5 01
Average <sup>5</sup> -----	\$0 78	\$15 75	\$1 63	\$1 94	\$3 23	\$6 96

<sup>1</sup>Includes all classifications.

<sup>2</sup>This is the item upon which the contractors bid in most cases; the state supplies the materials.

<sup>3</sup>Only a six-month period, January 1, 1920, to June 30, 1920.

<sup>4</sup>In 1912 the contractors in all cases except one furnished the concrete aggregates.

<sup>5</sup>Weighted average.

<sup>6</sup>In 1917 and 1918 the paving concrete was enriched from 1:2½:5 mixture to 1:2:4. In the prices stated, allowance has been made for this change.

These data show that during the war period the earthwork cost about 51 per cent and the concrete about 37 per cent more than during the pre-war period and that during the last biennium the earthwork has cost 60 per cent and the concrete 132 per cent more than they averaged to cost before the war.

It is also worth while to note that before the war the cost of cement delivered averaged \$1.70 per barrel, and that during the last biennium the average delivered price has been \$3.23 per barrel, or an increase of 81 per cent; also, that the labor, hauling and manipulation cost of the concrete shows an advance during the same interval from \$2.92 to \$6.96 per cubic yard, or 137 per cent.

It is true that cost of construction was on the upward trend in 1919, the year after the armistice, nevertheless, the fact that such cost would continue to increase for several years thereafter and that the subsequent decline would be very slow was not expected when the budget was prepared on the basis of which the \$40,000,000 bond issue was voted in 1919. With the hope that costs might more nearly have returned to normal before any appreciable expenditures had been made out of this last bond issue the estimates were based very largely on pre-war costs. The rapid advance in unit costs since that date, however, and the very slow subsequent decline, if any, in such costs, have resulted in such a decided increase in the total cost of construction that bond moneys voted to date will not begin to be sufficient to make it possible to complete the system. Many of the roads provided for in the bond issues will remain but half completed when the \$40,000,000 bond funds are completely exhausted.

There is an urgent necessity for widening and thickening the paving on the main highways of the state. This widening and thickening will require such a large expenditure of money that it will not be possible to provide for any new construction from the funds derived from motor vehicle license fees or other means of taxation, other than bond issues, for years to come.

It would therefore appear that if the state highway system is to be carried to completion the only solution is another bond issue at an early date, or failing that, large legislative appropriations of moneys from the general fund.

#### **HIGHWAY COSTS AND ADMINISTRATION EXPENSE.**

The table following shows the expenditures for state highway purposes from the beginning of the work to June 30, 1922.

The table also segregates these expenditures into the following items: Highways; Equipment and Stores; Engineering and Inspection in Connection with Contracts; Preliminary Surveys; Administration Expense at Division Offices and Administration Expense at Headquarters Office.

It is interesting to note that by June 30, 1922, of the total expenditure 88.17 per cent had been used for direct highway costs and equipment, while at the date, December 31, 1914, only 80.75 per cent went for such purposes.

The table also shows that the administration expense of the work (both headquarters and divisions) by June 30, 1922, had been reduced from 6.23 per cent to 4.68 per cent.

## DEPARTMENT OF PUBLIC WORKS.

## EXPENDITURES BY THE CALIFORNIA HIGHWAY COMMISSION TO JUNE 30, 1922.\*

ITEM	Total to June 30, 1922	July 1, 1921-June 30, 1922	July 1, 1920-June 30, 1921	Jan. 1, 1919-June 30, 1920	Jan. 1, 1917-Dec. 31, 1918	Jan. 1, 1916-Dec. 31, 1916	Mar. 1, 1912-Dec. 31, 1914
	AMOUNT PER CENT	AMOUNT PER CENT	AMOUNT PER CENT	AMOUNT PER CENT	AMOUNT PER CENT	AMOUNT PER CENT	AMOUNT PER CENT
Highways	57,119,924.93 83.972	15,319,363.95 86.830	6,975,390.54 78.641	9,866,330.75 82.932	8,356,652.43 84.697	11,147,095.96 87.423	5,496,091.60 78.436
Equipment, Plants & Stores	2,856,212.68 4.199	646,177.77 3.650	767,927.55 8.905	568,793.66 4.960	304,532.27 3.083	356,736.60 2.874	122,044.63 2.313
Total	59,976,137.61 88.171	15,965,541.72 90.480	7,763,317.99 87.747	10,395,124.61 87.912	8,670,184.70 87.780	11,523,832.56 90.297	5,659,136.13 80.749
Engineering and Inspection in connection with contracts	2,340,053.00 3.440	519,722.81 2.950	219,127.10 2.477	319,433.69 2.702	333,183.69 3.373	588,000.60 4.607	361,686.11 5.160
Preliminary Surveys	2,620,440.77 3.706	574,618.42 3.245	268,703.45 3.489	484,903.83 4.100	352,783.71 3.572	248,778.10 1.949	580,763.86 7.860
Administration Expense at Division Offices	2,005,650.77 2.949	363,051.42 2.061	370,911.70 4.192	423,712.14 3.668	334,987.18 3.392	244,868.38 1.919	289,124.15 3.684
Administration Expense at Headquarters Office	1,180,330.86 1.735	282,301.22 1.594	185,361.36 2.095	191,378.89 1.616	186,066.16 1.883	156,732.19 1.228	178,461.02 2.447
Total	9,046,465.40 11.829	1,739,593.97 9.880	1,084,109.61 12.253	1,425,438.55 12.088	1,207,040.76 12.250	1,239,369.07 9.703	1,348,925.64 19.261
GRAND TOTAL	69,022,603.01 100.000	17,704,135.59 100.000	8,847,427.60 100.000	11,824,553.16 100.000	9,877,225.46 100.000	12,762,201.63 100.000	7,007,069.67 100.000
FUNDS FROM WHICH EXPENDITURES WERE MADE:							
First State Highway Fund and Primitives	19,002,129.00						
Second State Highway Fund	14,876,882.42	1,097,125.39	86,013.38	6,212,777.64	212,866.05	10,966,139.13	6,933,123.82
Third State Highway Fund	18,710,116.47	10,649,408.82	4,617,783.80	3,242,923.86	7,540,955.82		
Motor Vehicle Fund	11,902,862.76	3,709,906.72	2,413,056.12	2,272,299.60	1,776,609.97	1,644,806.60	83,835.86
Federal Aid	3,586,887.31	2,254,615.01	1,272,640.54		59,571.76		
Contribution by Counties	943,785.06	54,079.66	257,684.66	91,682.87		251,365.00	
Total	68,082,603.01	17,704,135.59	8,847,427.60	11,824,553.16	9,877,225.46	12,762,201.63	7,007,069.67

\* Exclusive of Legislative appropriations for special surveys (Chapter 746, Statutes 1921) and of salaries of members of California Highway Commission and the Highway engineer.



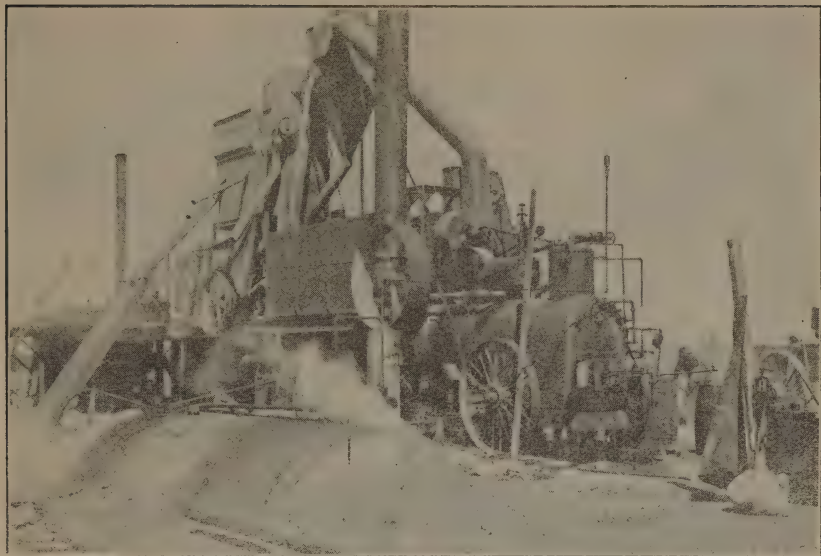


Plate XXVIII. State Highway, asphalt plant in operation, Colorado Desert, Imperial County.



Plate XXIX. State Highway, Merced County, showing thickening or second story work.

In like manner the preliminary survey percentage was reduced from 7.86 per cent to 3.70 per cent on June 30, 1922, and the engineering and inspection expense from 5.16 per cent to 3.44 per cent.

It will be noted that during the last biennium when the construction work has proceeded at a more uniform rate than was possible during the previous years a stabilization of the organization not possible in previous years resulted, and the administration expense was reduced to 3.64 per cent, this notwithstanding the fact that during the last two years the Commission has participated in much research and special investigational work, such as the Pittsburg test highway, traffic regulation and traffic census, (more fully described hereafter) the cost of which special work is charged against the cost of administration and not as a direct highway construction charge.

#### THICKNESS OF CONCRETE BASE.

Early in the report a table is given showing the several types of work in the state highway system. It is shown there that of 1968.45 miles of paved road 1706.47 miles have been constructed with a Portland cement concrete base.

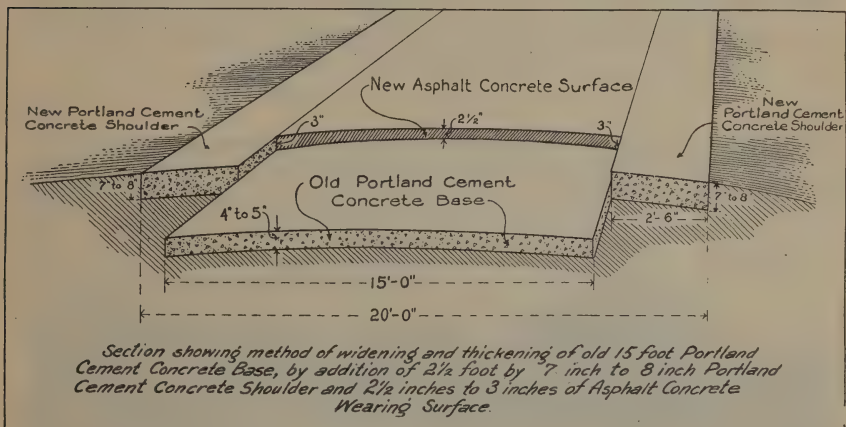
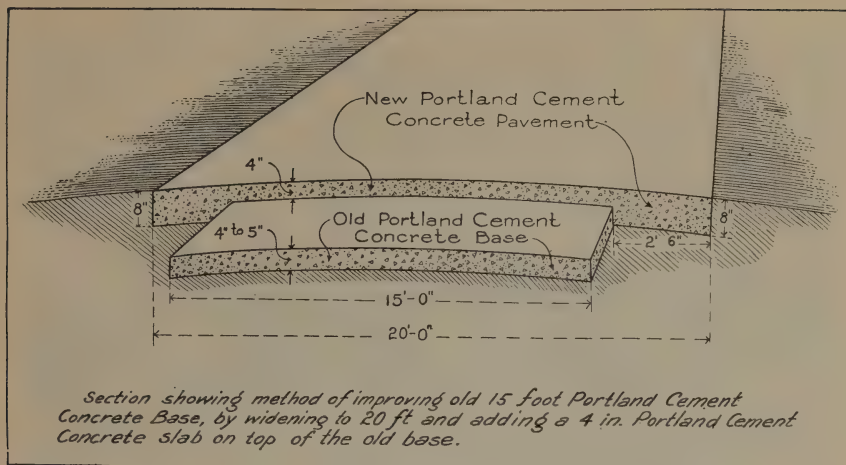
As was pointed out in the 1920 report of the California Highway Commission, in the California work there is no such thing as a *concrete road* as the term is technically understood. The roads are not like, or have they ever been intended to be like, the concrete roads of the East and the Middle West. There a heavy concrete pavement, often as thick as eight inches, is laid as the ultimate road. The concrete is mixed very rich in cement and the concrete is intended to remain without surface of any sort, the concrete itself to serve as a wearing surface.

At present on the California state highways, no Portland cement concrete bases are being constructed less than five inches in thickness and the thickness is increased to six inches and sometimes to an even greater thickness where subgrade conditions are particularly adverse.

However, even though it is and always has been the intention of the California Highway Commission that the four- and five-inch Portland cement concrete bases should be ultimately surfaced with an asphalt surfacing, when the funds therefor became available, nevertheless, it is a fact that under California climatic conditions and where the subgrade conditions are good the five-inch Portland cement concrete and in many cases even the four-inch Portland cement concrete bases have stood up for many years under heavy traffic without serious depreciation. In fact, many of the sections of four-inch base built from seven to nine years ago are in such good condition today that an expensive thickening program is not justified until some of the later constructed sections in the more heavily traveled districts are widened and thickened.

In 1912 there were fewer than 100,000 motor vehicles in the state, whereas, the records of the Motor Vehicle Department show more than 816,000 to date for 1922.

Even though the earlier built pavements have stood up remarkably well under the heavy increase in traffic, nevertheless, they were not originally constructed to stand the traffic which they are called upon to bear today and are rapidly getting in such condition that extensive reconstruction will be necessary, unless funds are provided at an early date for widening and thickening.



It was the hope of the Commission that a gasoline tax would be adopted at the last session of the state legislature, thus providing funds for a comprehensive program of widening and thickening the main trunk line highways of the state. Owing to the failure of the legislature, however, to pass any remedial measures of this nature, the Commission has been unable, during the past two years, to carry on more than a very limited widening and thickening program.

In Appendix P is a table showing all of the work of this nature which has been done to date on the state highway system.

There is an imperative need for augmented motor vehicle funds, or perhaps better, for a new fund such as might be created by a gasoline tax, which can be devoted exclusively to the work of widening and thickening the 15-foot bases.





Plate XXX. State Highway, Los Angeles County, showing widening and thickening of old concrete base.



Plate XXXI. State Highway, San Benito County, showing widening and thickening of old concrete base.



### NEW BUILDINGS.

In Appendix D will be found a description of the new repair shops and testing laboratory erected during the past year at headquarters in Sacramento.

The large number of motor trucks and other surplus war equipment received from the United States government have made it necessary to provide extensive storage facilities in Sacramento and also shop facilities for repairing and overhauling this equipment.

The chemical testing laboratory, which up to 1921 was under the direction of the State Purchasing Agent, was as a result of the organization of the Department of Public Works, placed under the jurisdiction of the Division of Highways.

The large number of physical tests being carried out at the California Highway Commission physical testing laboratory, together with the work of the chemical testing laboratory, made it necessary to erect adequate quarters for the conduct of this work and a new testing laboratory building has been recently completed which will be fully equipped to handle all of the needed tests and analyses.

The blueprinting and photostating departments are likewise housed in the testing laboratory building.

### EXPERIMENTAL AND RESEARCH WORK.

As in previous years, the Commission has conducted and has participated in much experimental and research work during the past two years.

Special research work is being carried on throughout the United States on a much more extensive scale at the present time than ever before in the history of highway building and just as California has always been to the front in her road construction program so has the Commission taken a leading part in the research work conducted by state and governmental organizations.

### PITTSBURG TEST HIGHWAY.

The most extensive work of this nature conducted by the California Highway Commission, in cooperation with the United States Bureau of Public Roads, is the test highway at Pittsburg, California. This highway was built in 1921 by the Columbia Steel Company of Pittsburg for the purpose of testing to destruction, if possible, sections of Portland cement concrete base constructed under varying specifications for thickness, cross-section and reinforcement.

The work was taken over in 1922 by the United States Bureau of Public Roads and the California Highway Commission as a cooperative project and all traffic tests were completed on July 27, 1922.

A detailed report giving the results of the tests is now in preparation and it will be published at an early date. It is therefore not necessary at the present time to go into a more lengthy discussion of this test.

### SUBGRADE TREATMENT.

Special subgrade treatment has been carried on through a section of adobe country in Solano County, between Denverton and Rio Vista, the object of the test being to determine, if possible, an economical method

of treating adobe so as to eliminate the swelling and the plastic condition of that kind of soil when saturated with moisture and the subsequent shrinkage and cracking when dried out. The plan was to mix with the soil Portland cement, hydrated lime, limestone dust, and asphaltic oil in varying proportions.

The work was started in November, 1921, four sections of cement mixture being partially completed before the wet weather compelled the suspension of work.

On account of the partial completion only of this portion a complete new start was made when the work was again taken up in the spring of 1922.

Eleven 500-foot sections and one 380-foot section were treated as follows:

Section 1, Station 177+50 to 182+50, 1:10 cement mixture.....	12" depth
Section 2, Station 182+50 to 187+50, 1:20 cement mixture.....	12" depth
Section 3, Station 194+00 to 199+00, 1:10 cement mixture.....	6" depth
Section 4, Station 212+00 to 217+00, 1:20 cement mixture.....	6" depth
Section 5, Station 217+00 to 222+00, 1:20 hydrated lime.....	12" depth
Section A, Station 248+50 to 253+00, 1:10 cement mixture.....	6" depth
Section B, Station 253+50 to 258+50, 1:20 cement mixture.....	6" depth
Section C, Station 258+50 to 263+50, 1:20 cement mixture.....	12" depth
Section D, Station 263+50 to 267+30, 1:10 cement mixture.....	12" depth
Section 6, Station 268+00 to 273+00, 1:20 limestone dust.....	12" depth
Section 7, Station 273+00 to 278+00, No foreign substance	
Section 8, Station 278+00 to 283+00, 60% asphaltic oil.....	12" depth

It was necessary to select segregated sections, as there was no stretch of road which would permit of continuous sections. The work done late in 1921 consisted of four sections of cement mixtures, located between Stations 248+50 and 267+30, a total length of 1880 feet.

Heavy adobe soil was found in the above locations. This soil was turned up with a heavy 5-disc plow, drawn by a 75 horsepower tractor, later superseded by a 60 horsepower tractor. The plowing was followed by a spike-tooth harrow and roller to break up the clods.

Sections 6, 7 and 8 were continuous, and were the first to be worked. These sections broke up in hard lumps, as this grade stood over the winter and was well compacted by rains and traffic, and had to be plowed 6 times and harrowed 8 times, the operation of plowing and harrowing being done separately after the first time over it.

Sections 1 and 2 were then plowed, and the soil turned up damp; these two sections were then left to dry out, and sections 3, 4 and 5 were plowed, then sections 1 and 2 turned over again.

Sections 1, 2, 3, 4 and 5 were then plowed and harrowed three more times to a width of 21 feet and a thorough pulverization ( $\frac{1}{4}$ "- $\frac{1}{2}$ ") of the soil was secured.

The cement, hydrated lime and limestone dust were spread by hand. The asphaltic oil was spread with a 500-gallon capacity oiler, using a pressure spray, and was applied cold.

The oil was hauled from Garfield station on the San Francisco and Sacramento Railway, a distance of approximately three and one-half miles.

After the cement, hydrated lime and limestone dust had been spread, these sections were plowed and harrowed three times and a very



Plate XXXII. State Highway, Solano County, subgrade treatment adobe soil, cement mixture 1 part to 20, six inches deep.



Plate XXXIII. State Highway, Solano County, subgrade treatment, showing oil mixed with adobe soil, twelve inches deep.



thorough mixing of the cement, hydrated lime and limestone dust with the soil was secured. After every second application of oil, section 8 was plowed and harrowed three times in all, the oil being thoroughly mixed with the soil at the rate of 5 gallons per square yard.

The sections then were shaped and rolled dry. The contractor next proceeded to water and roll sections 5, 6 and 7, and place his header boards and build the subgrade.

The oil section worked up well and formed a very solid subgrade. The plain adobe section, 7, showed a great many cracks after watering and rolling. The limestone section, 6, showed numerous surface checks to a depth of one-half inch. The hydrated lime section, 5, showed numerous fine checks after watering and rolling.

The cement sections placed in 1921 were fairly free from checks between Stations 258+50 and 267+30. From stations 248+50 to 258+50, there were numerous checks from  $\frac{1}{2}$ " to 1" deep.

After the subgrade was treated as above described a Portland cement concrete slab 18 feet wide and 5 inches thick was constructed thereon. Observations will be taken from time to time on the action of the pavement constructed over the treated and untreated sections, to ascertain the benefit, if any, of such special subgrade treatment.

#### PRECAST SLAB.

Another experimental section of highway is now under construction in Solano County from Suisun easterly. A portion of this section will be constructed of precast slabs. These slabs, of varying dimensions, are now being cast in a casting yard in the city of Suisun. As soon as they have cured sufficiently the slabs will be transported to the site of the work and installed.

#### EXPANSION JOINTS.

On another portion of the same section the concrete is being cast in place with expansion joints. Steel dowels will be placed connecting the sections of pavement at the expansion joints on a portion of the work and on the remainder these dowels will be omitted. The object of this experiment is to determine whether installation of the dowels at expansion joints will prevent the tendency of the adjoining slabs to buckle, thus making the pavement rough for traffic.

#### WILLITE.

Some experimental work has been done in connection with the construction of a patented pavement, known as Willite. The proponents of this patented pavement claim that by the addition of a certain small percentage of copper sulphate to an asphaltic mixture the mixture is toughened and rendered more stable than is standard asphaltic concrete, Topeka or sheet asphalt mixture, thus enabling a poorly graded mixture of sand and rock or a mixture of very fine blow sand and asphalt to be used where better materials can not be secured economically.

As some of the state highways in California must be built across desert sections where the importation of road building materials is very expensive and where the local materials are relatively inferior, it was felt



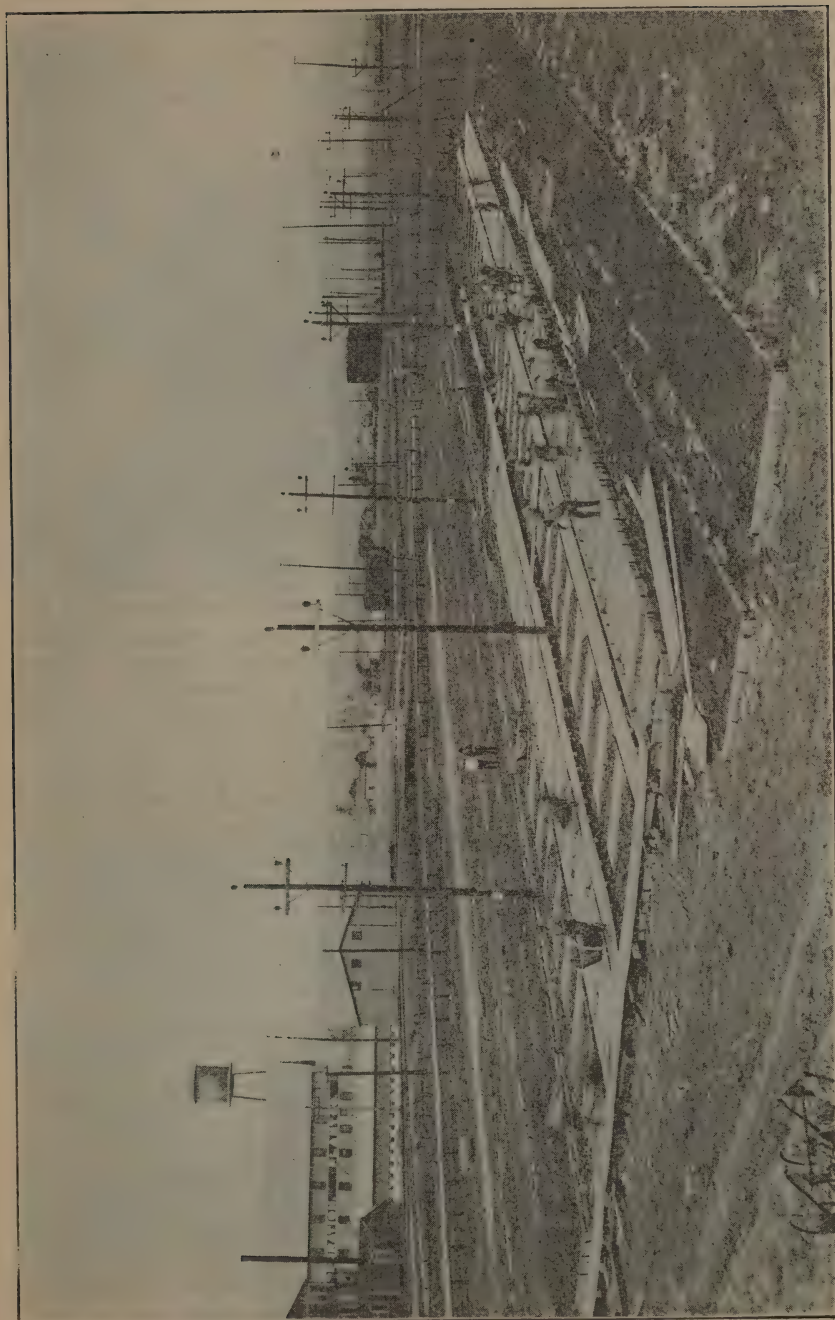


Plate XXXIV. State Highway, precast slab construction, showing casting yard at Suisun, Solano County.

that the investigation of a pavement designed to overcome the peculiar difficulties encountered under such conditions was justified.

A contract was entered into for the construction of a ten-mile section in Imperial County from the Highline Canal east of Holtville, easterly, under the Willite specifications, and this work is now under construction.

Some two years ago, a short section, approximately one mile in length was constructed in the same locality under the same specifications. Some pavement has likewise been laid in the same locality without the copper sulphate, but with the use of a harder asphalt.

To date, no advantages have been noted in the pavement built under the Willite patent, which would indicate that this type of pavement has any superiority over the standard asphalt mixture properly constructed with the same aggregates.

Two short sections of Willite surfacing on Portland cement concrete base have been constructed, one section in Tulare County west of Visalia, and one section on the Ridge Route, near Castiac, in Los Angeles County. Results there, however, do not indicate any advantage in this type which would justify further experimentation with the Willite type of pavement.

#### ALKALI SOILS.

Experiments have been continued also at the testing laboratory to ascertain the action of the alkali soils encountered on the routes of the state highway in California, on two sections of state highway in Los Angeles and Kern counties, between Lancaster and Mojave. Where alkali was apparent in the soil the subgrade was treated with a light grade of asphaltic oil.

#### MAINTENANCE.

In Appendix O will be found a detailed statement of the expenditures for maintenance, together with an analysis of the expenditures.

There were on June 30, 1922, approximately 3595 miles of highway, both graded and paved, under maintenance by the California Highway Commission, an increase during the last two years of 490 miles. These highways then had been under the jurisdiction of the Commission and under maintenance by the Commission an average of 5.06 years.

A total to June 30, 1922, of \$10,882,426.94 had been expended on general maintenance and for resurfacing, widening and thickening during the entire period that these roads have been under maintenance, or an average expenditure of \$597.84 per mile per year. Of the total mileage approximately 1968.45 miles are paved and have been under maintenance an average of 4.13 years.

The greater part of the 15-foot by 4-inch concrete base was built during the first three or four years of state highway construction.

An analysis of the maintenance expenditures on these early built roads shows a very low expenditure for the length of time they have been in use.

In 1912, the first year of construction, contracts were let for approximately 100 miles of 15-foot by 4-inch concrete base roads.

On June 30, 1922, these roads had been under traffic an average of 8.22 years. There has been a total expenditure of \$348,991.29 for



Plate XXXV. Precast slab construction at Suisun, Solano County.



Plate XXXVI. Precast slab construction at Suisun, Solano County.





Plate XXXVII. State Highway, Sonoma County, completed concrete base.



Plate XXXVIII. State Highway, San Benito County, showing concrete mixer in operation for widening and thickening old concrete base.



maintenance and replacements of the pavement itself throughout this entire period, or approximately \$3,551.71 per mile. The average expenditure for maintenance and replacements of the pavement base and surface has been \$432.05 per mile per year.

The above figures are exclusive of widening and thickening expenditures. Twenty-one and ninety-eight hundredths miles or 22.37 per cent of the above 100 miles constructed in 1912 have been widened and thickened.

The lowest cost per mile per year has been in Placer County, between the southerly boundary and Lincoln. On this section an average of but \$227.07 has been expended per mile per year for maintenance and replacements of both base and surface during the period of 8 years that this road has been under maintenance.

### FEDERAL AID HIGHWAY WORK.

Following is a table showing federal aid apportionments to California to date:

#### FEDERAL AID ALLOTMENTS.

##### \$75,000,000 Fund.

Fiscal year ending June 30, 1917	\$151,063 92
Fiscal year ending June 30, 1918	302,127 84
Fiscal year ending June 30, 1919	456,167 23
Fiscal year ending June 30, 1920	609,699 32
Fiscal year ending June 30, 1921	763,668 88
Sub-total	\$2,282,727 19

##### \$200,000,000 Fund.

Fiscal year ending June 30, 1919	\$1,524,248 30
Fiscal year ending June 30, 1920	2,286,372 45
Fiscal year ending June 30, 1921	2,291,006 63
Sub-total	6,101,627 38

##### \$75,000,000 Fund.

Fiscal year ending June 30, 1922	\$2,462,098 53
Sub-total	2,462,098 53
Total to 1922	\$10,846,453 10

##### \$190,000,000 Fund.

Fiscal year ending June 30, 1923	\$1,641,399 02
Fiscal year ending June 30, 1924 (estimated)	2,133,818 72
Fiscal year ending June 30, 1925 (estimated)	2,462,098 53
Sub-total	6,237,316 27

Total federal allotments to California other than Forest highways	\$17,083,769 37
---	-----------------

#### FOREST HIGHWAY FUND.

Total apportionment to California under the Federal Aid Act approved November 9, 1921	\$1,460,871 00
Deductions by United States Government:	
10 per cent overhead	\$146,087 00
10 per cent contingencies	146,087 00
Total deductions	292,174 00
Net amount available for construction	\$1,168,697 00
Apportionment not yet made under act approved June 19, 1922.	

## DEPARTMENT OF PUBLIC WORKS.

## RECORD OF FEDERAL AID PROJECTS, JUNE, 30, 1922.

[illegible]

Balance available based on "Amount Recommended" in Project Agreement unless otherwise noted.

Final Voucher, "Balance Available" based on this amount.  
Total does not include amounts shown for Projects 84, 89, 141, 154, 184, 471, 1044.

## RECORD OF FEDERAL AID PROJECTS, JUNE 30, 1922.

[illegible]



At the time the last biennial report was written \$8,384,354.57 had been apportioned to California under the Federal Aid Highway acts of 1916 and 1919.

The Third Federal Highway Act was adopted by the Sixty-seventh Congress in 1921 and under this act \$75,000,000 was appropriated for co-operative work with state highway departments as in the previous acts, and an additional \$15,000,000 for the survey, construction, reconstruction and maintenance of forest roads and trails. This act was approved November 9, 1921 (S. 1072).

Of the \$15,000,000 appropriated for work on forest roads and trails it was provided that a portion should be expended under the direct supervision of the Secretary of Agriculture in the survey, construction, reconstruction and maintenance of roads and trails of primary importance, for the protection, administration, and utilization of the National Forests, or when necessary, for the use and development of resources upon which communities within or adjacent to the National Forests are dependent to be apportioned among the several states, Alaska and Porto Rico, by the Secretary of Agriculture, according to the relative needs of the various National Forests, taking into consideration the existing transportation facilities, value of timber, or other resources served, relative fire danger, and comparative difficulties of road and trail construction.

It was further provided that the balance of the appropriation for forest road work should be expended by the Secretary of Agriculture in the survey, construction, reconstruction and maintenance of forest roads of primary importance to the state, counties and communities within, adjoining or adjacent to the National Forests, and that such balance should be prorated and apportioned by the Secretary of Agriculture for expenditures in the several states, Alaska and Porto Rico, according to the area and value of the land owned by the government within the National Forests therein as determined by the Secretary of Agriculture from such information, investigation, sources and departments as the Secretary of Agriculture might deem most accurate.

The fund set aside to be expended under the direct supervision of the Secretary of Agriculture on roads and trails of primary importance for the protection, administration and utilization of the National Forests or for the use and development of the resources thereof is known as the "Forest Development Fund" and the fund to be expended on roads of primary importance to the state, counties and communities within, adjoining or adjacent to the National Forests is known as the "Forest Highway Fund."

Before moneys are expended from the "Forest Highway Fund" the approval of the State Highway Commission must be secured.

Under the 1921 act there has been apportioned to California from the forest highway fund the sum of \$1,460,871. Of this amount \$292,274 has been reserved by the government to cover overhead and contingencies, making a net amount available for forest highway construction in California of \$1,168,697.

On June 19, 1922, the fourth Federal Aid Act adopting a three-year program for federal aid was approved. This act made \$50,000,000 immediately available for the fiscal year ending June 30, 1923, and committed the government to subsequent appropriations of \$65,000,000 for





Plate XXXIX. State Highway, Del Norte County, steam shovel in operation on heavy construction.

the fiscal year ending June 30, 1924, and \$75,000,000 for the fiscal year ending June 30, 1925, or a total of \$190,000,000 for the three-year period.

Federal aid apportionments to California for 1923 and estimated apportionments for 1924 and 1925 are given in the previous table.

This last act likewise contained additional appropriations for forest highway work for the fiscal year 1924 and 1925.

#### **GRADUATED SCALE OF FEDERAL AID. FOR THE PUBLIC-LAND STATES.**

The acts of 1916 and 1919 provided for cooperation by the government at not to exceed 50 per cent of the cost of the work.

Most of the western states have within their boundaries large areas of unappropriated government lands from which the states derive no revenue with the result that such states are unable to raise as much revenue for highway construction purposes in proportion to the total area of the state as is possible in states where there is no public land. Congress recognized this unfairness and in the Federal Highway Act of 1921 what is known as the "Graduated Scale of Federal Aid for the Public-Land States" was adopted.

The act provided that the United States government should pay not to exceed 50 per cent of the total estimated cost of projects, except that in the case of any state containing unappropriated public lands exceeding 15 per centum of the total area of all lands in the state, the share of the United States payable under the act on account of such projects should not exceed 50 per centum of the total estimated cost, plus a percentage of such estimated cost equal to one-half of the percentage which the area of the unappropriated public lands in such state bears to the total area of such state.

Under this provision California is only required to pay 40.68 per cent of the cost of work done under Federal Aid Highway Projects, the government providing the remaining 59.32 per cent.

The last Federal Act of 1922 contains the same provisions relative to the graduated scale of federal aid.

#### **SEVEN PER CENT SYSTEM.**

The Federal Aid Act of 1921 likewise provided that before any projects could be approved in any state such state through its State Highway Department should select or designate a system of highways not to exceed seven per centum of the total highway mileage of such state, as shown by the records of the State Highway Department thereof at the time of the passage of the act, and that upon this seven per cent system all federal aid apportionments should be expended.

The act further provided that the highways in the seven per cent system to receive federal aid should be divided into two classes, one to be known as "Primary or Interstate Highways" and not to exceed three-sevenths of the total mileage to receive federal aid, and the other, which should connect or correlate therewith, to be known as "Secondary or Inter-County Highways," and which should consist of the remainder of the mileage which would receive federal aid.

Under the provisions of the above section of the Federal Aid Act of 1921, the California Highway Commission on February 2, 1922, ap-





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STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS  
CALIFORNIA HIGHWAY COMMISSION

# ROAD MAP OF THE STATE OF CALIFORNIA

Compiled from Maps in the United States Government and from various County Maps  
under the Direction of  
ALVIN R. FLETCHER, STATE HIGHWAY ENGINEER

COMMISSIONERS  
NEWELL H. DAWLINGTON (Chairman)  
CHARLES A. WHELFORD  
GEORGE A. MANFRED

Scale 1:100,000  
1922

## FEDERAL AID HIGHWAY SYSTEM

LEGEND  
— PRIMARY ROADS  
- - - SECONDARY ROADS  
..... ADDITIONAL SECONDARY ROADS

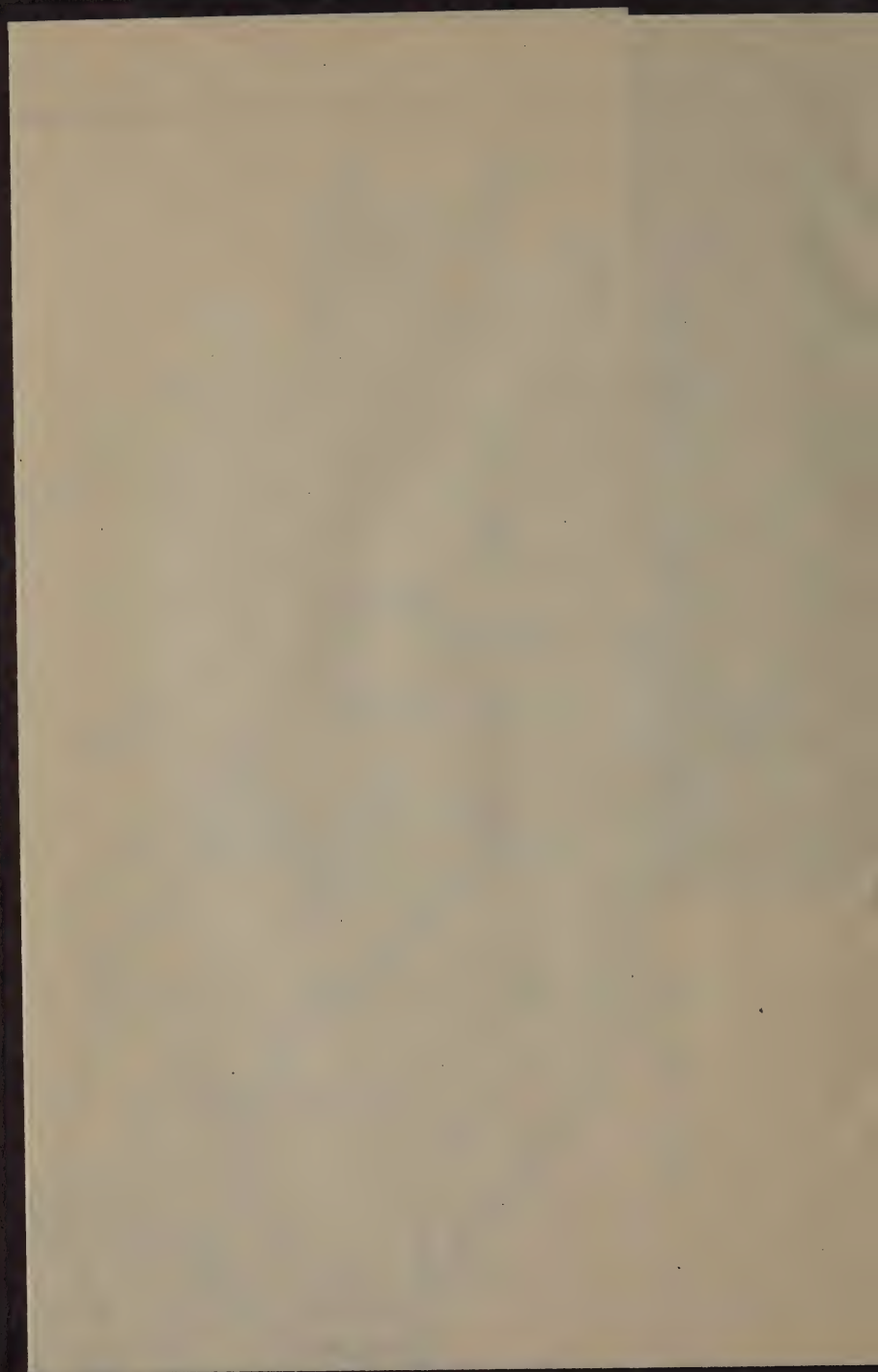
February 1, 1922

I recommend the approval of this map of  
the State of California showing the seven  
per centum system of highways to receive  
Federal Aid.

T. E. Stanton  
Assistant State Highway Engineer

APPROVED:

*Alvin R. Fletcher*  
State Highway Engineer  
*Charles A. Wheford*  
George A. Manfred  
California Highway Commission





proved a map of the State of California showing the seven per cent system of highways to receive federal aid and recommended such system to the Secretary of Agriculture.

The total highway mileage of the State of California was determined by the Commission to have been 70,000 miles at the time of the adoption of the Federal Aid Act. Of this mileage three per cent or 2100 miles could have been designated as primary roads and four per cent or 2800 miles as secondary roads, making a total seven per cent system of 4900 miles. The Commission designated 2014.9 as primary roads and 2432.7 as secondary roads, a total of 4447.6 miles. Twenty additional miles were added to the secondary roads on August 31, 1922, making a total designated mileage in the seven per cent system at the present date of 2014.9 miles primary roads and 2452.7 miles of secondary roads, or a total of 4467.6 miles, leaving 85.1 miles still to be designated in the primary system and 347.3 miles in the secondary system.

## SEVEN PER CENT FEDERAL AID HIGHWAY SYSTEM.

## Primary Roads.

Route	Description	Length, miles
1	Oregon line to San Francisco-----	410.0
2	San Francisco to San Diego-----	499.0
3-7-6	Oregon line to Sacramento-----	295.6
4	Sacramento to Los Angeles-----	357.4
12-27	San Diego to Yuma-----	170.6
14-7-3 17-37	San Francisco to Verdi-----	193.0
5	San Jose to French Camp-----	84.3
Total mileage primary roads-----		2,014.9

## Secondary Roads.

9-26	Los Angeles to El Centro via San Bernardino-----	203.2
31-58	San Bernardino to Needles via Barstow-----	240.0
	Needles to Arizona line at Mellen-----	16.0
	Route 58 near Goffs to Nevada line-----	25.0
63	Big Pine to Oasis-----	38.6
	Oasis to Nevada line-----	4.4
29	Red Bluff to Susanville-----	107.5
21	Richvale Junction to Quincy-----	93.4
3	Roseville to Red Bluff-----	116.9
23	Saugus to Bridgeport-----	330.1
55	Skyline Boulevard-----	62.1
5	San Jose to Santa Cruz-----	33.1
32	Gilroy to Califa-----	83.5
18	Merced to Yosemite National Park via El Portal-----	70.5
15-17	Ukiah to Cisco-----	165.0
28	Redding to Alturas-----	157.7
	Alturas to Oregon line-----	35.0
20	Redding to Route 1 via Weaverville-----	161.6
45	Willows to 3 miles north of Biggs-----	32.2
11	Sacramento to Nevada line via Placerville-----	107.9
10	San Lucas to Sequoia National Park via Visalia-----	149.0
57	Santa Maria to Freeman via Bakersfield and Walker's Pass-----	200.0
1	Crescent City to Oregon line (via Coast)-----	20.0
Total mileage secondary roads-----		2,452.7

## Summary.

Total length primary roads-----	2,014.9 miles
Total length secondary roads-----	2,452.7 miles
Total length of system-----	4,467.6 miles



Plate XL. State Highway, Monterey County, showing gas shovel in gravel pit.



Plate XLI. State Highway, Mendocino County, steam shovel in operation.

The seven per cent roads have been confined by the California Highway Commission entirely to the state highway system of the state, except in three or four cases where it was necessary to add a small mileage outside of the state highway system in order to make a connection with the seven per cent system of an adjoining state.

As there are over 6400 miles of road in the state highway system and only 4900 miles can be designated in the seven per cent system as roads to receive federal aid, it is apparent that for some time to come the seven per cent system will have to be confined to the state highway system.

The seven per cent system adopted by the California Highway Commission has been approved by the Secretary of Agriculture.

#### FOREST HIGHWAY SYSTEM.

While the Federal Aid Act does not require that the roads improved from the forest highway fund shall be confined to the seven per cent or to the state highway system, nevertheless, inasmuch as projects under this fund are referred to the State Highway Commission for approval, and also, inasmuch as it was felt by the Highway Commission that when the people of the state voted bond issues designating certain roads of the state to be included in the state highway system, such roads were considered as of primary importance to the state, counties and communities, and also, inasmuch as the funds provided for these roads to date are far insufficient to complete the system through the National Forests, the Commission has consistently refused to approve the allotment of any forest highway funds to any projects not on the state highway system, until the roads on the state highway system in and adjacent to the National Forests have been improved.

On February 7 and 8, 1922, a conference was had in San Francisco between officials of the Federal Forestry Service, U. S. Bureau of Public Roads and the California Highway Commission, relative to application of the forest highway funds allotted to California under the 1921 Federal Aid Act.

It was determined that \$1,168,697 would be available from the forest highway fund for construction work in California.

In order to demonstrate the fact that there was sufficient work to be done on the state highways of California in and adjacent to the National Forests to absorb all of the forest highway funds which might be allotted for several years to come, the Highway Commission submitted the following list of projects under the seven per cent system on which expenditures might be made to advantage from the forest highway fund:

Crescent City to Oregon line -----	\$200,000 00
Redding to Alturas -----	200,000 00
Red Bluff to Susanville -----	200,000 00
Feather River Route -----	400,000 00
Auburn to Nevada line -----	200,000 00
Mariposa to El Portal -----	400,000 00
Cuyama Road -----	200,000 00
Viejas Grade to Pine Valley -----	200,000 00
Placerville to Lake Tahoe -----	200,000 00
Big Pine to Oasis -----	200,000 00
Kern River to Walker Pass -----	200,000 00
Trinity River Road -----	200,000 00
Total -----	\$2,800,000 00



Under date of February 8, 1922, E. A. Sherman, associate forester, acknowledged receipt of the above list of projects and advised that, if the Secretary of Agriculture placed upon the Forest Service the responsibility for the expenditure of the forest highway fund, he would recommend that favorable consideration be given to specific projects, as follows:

Crescent City to Oregon line .....	\$200,000 00
Redding to Alturas .....	200,000 00
Red Bluff to Susanville .....	200,000 00
Cuyama Road .....	292,500 00
Big Pine to Oasis .....	123,697 00
Big Bear Project in San Bernardino County .....	152,500 00
Total .....	\$1,168,697 00

Or the amount available for such construction in California as of that date.

It will be noted that the forester added \$152,500 for construction on what is known as the "Big Bear project" in San Bernardino County, and also added \$92,500 to the Cuyama road.

The Commission accepted the addition of the Big Bear project inasmuch as this project was on a portion of the state highway system, and therefore did not materially depart from the attitude of the Commission that all such moneys should be expended on the state highway system, but preferably on the seven per cent system. Exception was taken, however, to adding \$92,500 to the Cuyama project, because of the fact that this \$92,500 had been previously pledged by the Forest Service from the forest moneys appropriated under previous Federal Aid acts and it was felt that the Forestry Service should not default on such commitments from previous appropriations and charge this amount against the 1921 allotment. At a subsequent conference the Forestry Service agreed to this viewpoint.

At a conference between the U. S. Bureau of Public Roads and the District Forester in San Francisco on March 28, 1922, the District Forester stated that he was willing to approve the following program, and also to recommend an additional allotment to the Cuyama project of \$92,500 from other funds, if the California Highway Commission would approve of an allotment of \$168,697 from forest highway funds to the Big Bear Valley project in fulfillment of the Forest Service commitment to cooperate with the state on the construction of that project. The program was as follows:

Project	Forest highway funds.
Crescent City-Oregon Line .....	\$200,000 00
Redding-Alturas .....	200,000 00
Red Bluff-Susanville .....	200,000 00
Cuyama .....	200,000 00
Auburn-Verdi .....	200,000 00
Big Bear Valley .....	168,697 00
10 per cent overhead .....	146,087 00
10 per cent reserved for contingencies .....	146,087 00
Total .....	\$1,460,871 00

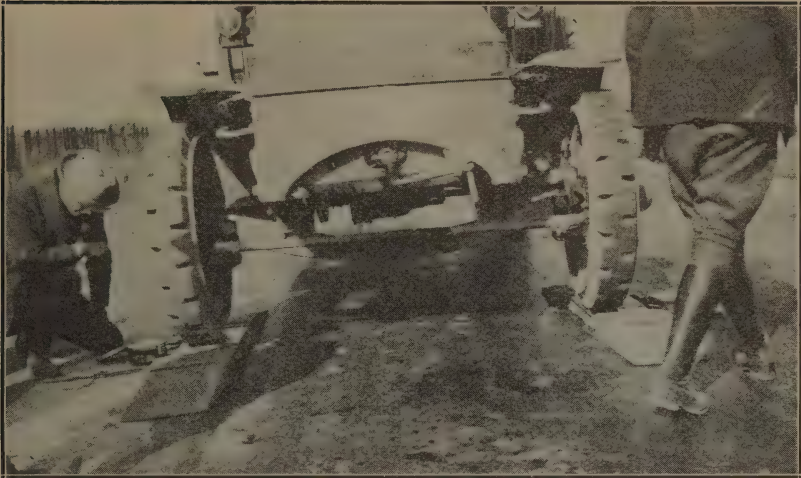


Plate XLII. State Highway, method of weighing loaded trucks with Berry scales.

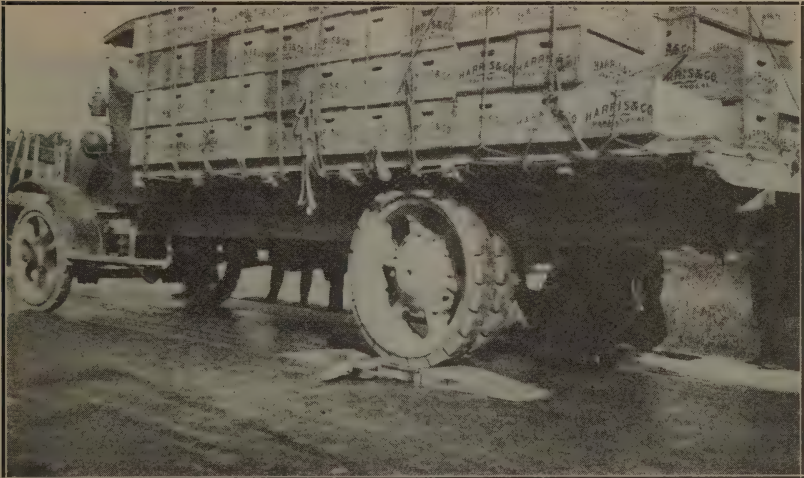


Plate XLIII. State Highway, method of weighing loaded trucks with Berry scales.

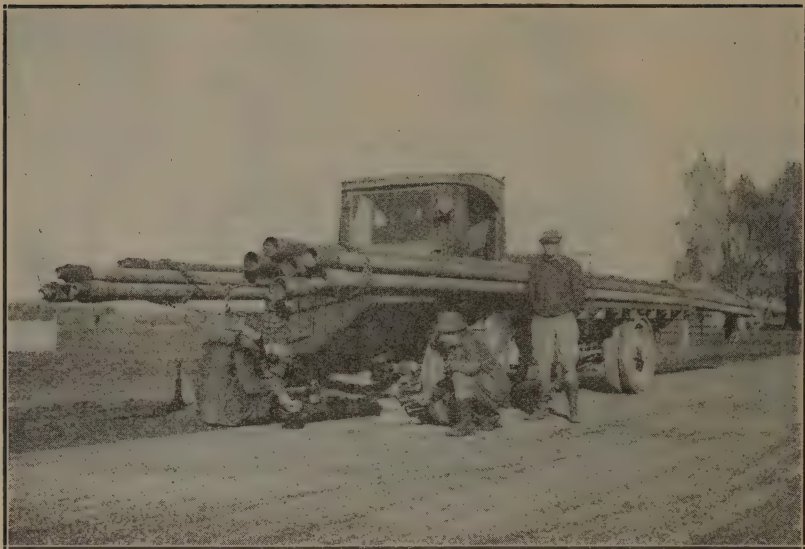


Plate XLIV. State Highway, heavily loaded truck being weighed with loadometers.

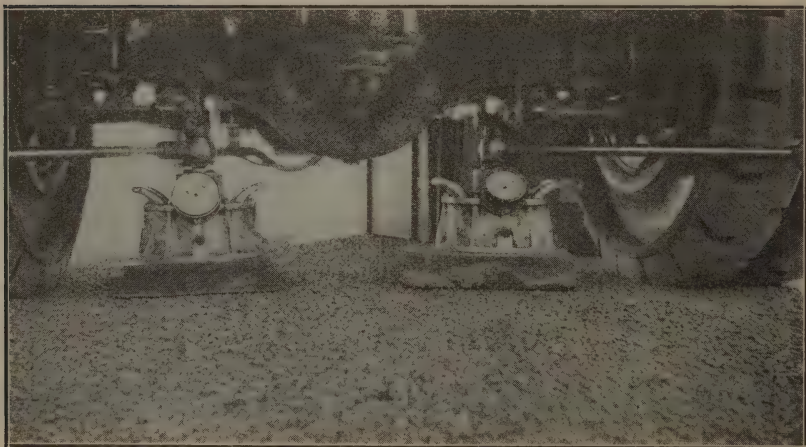


Plate XLV. State Highway, heavily loaded truck, loadometers under rear axle.





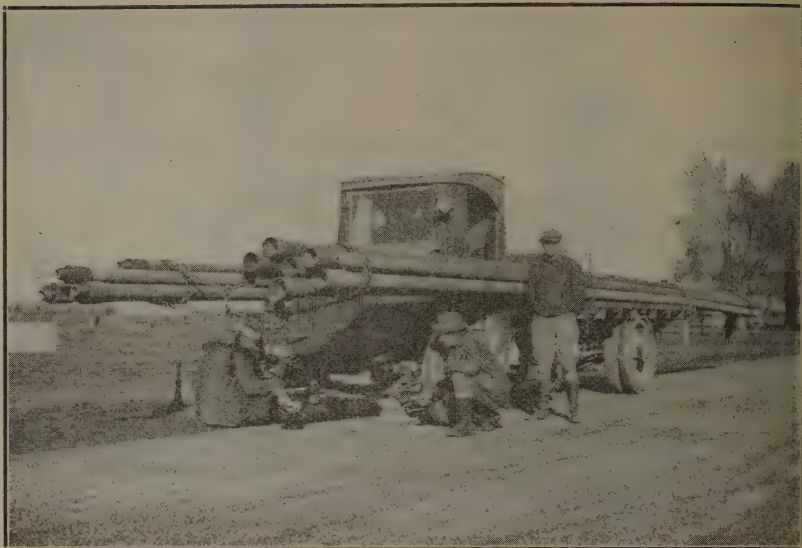


Plate XLIV. State Highway, heavily loaded truck being weighed with loadometers.

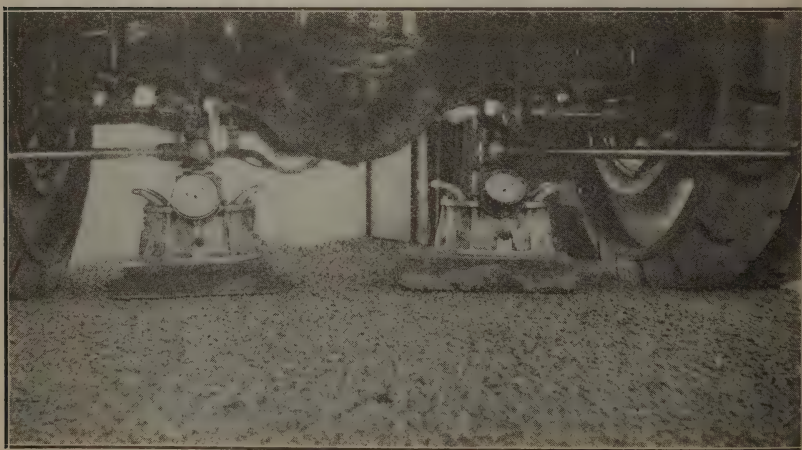


Plate XLV. State Highway, heavily loaded truck, loadometers under rear axle.



STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS  
CALIFORNIA HIGHWAY COMMISSION

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under the Direction of  
AUSTIN R. FLETCHER, STATE HIGHWAY ENGINEER

COMMISSIONED BY  
NORVELL B. DARTINGTONS (Chairman)  
CHARLES A. WHITEHORE  
GEORGE C. MANSFIELD

Scale: 1:100,000

1922

MAP  
SHOWING  
THE FOREST HIGHWAY SYSTEM

LEGEND  
PRIMARY ROADS  
SECONDARY ROADS

October 5, 1922

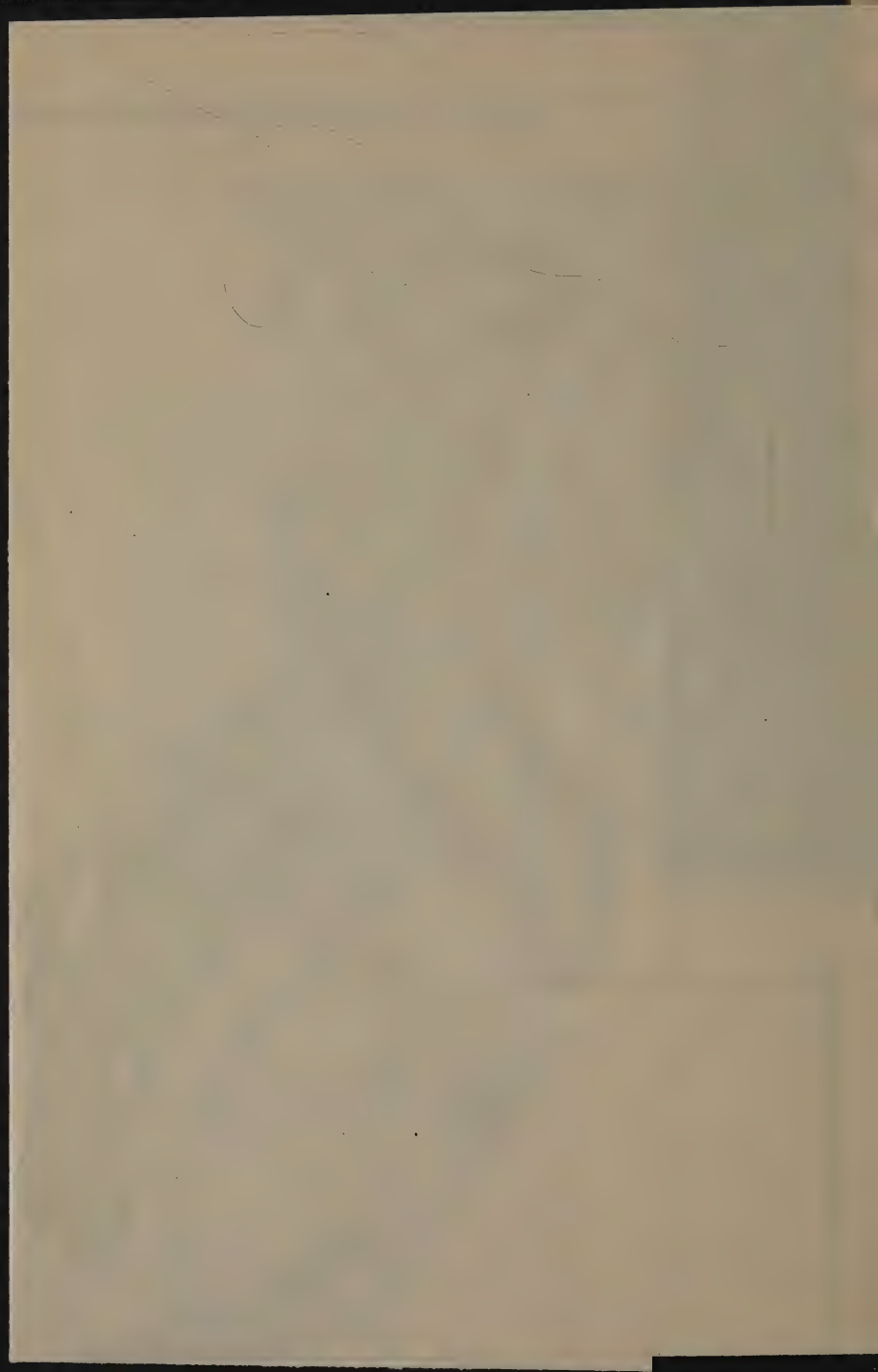
I recommend the approval of this  
map of the State of California showing  
the Forest Highway System to receive  
Federal Aid.

T. E. Stanton  
Assistant State Highway Engineer

APPROVED  
Director of Public Works and State Highway Engineer

*Charles A. Whitehore*  
George C. Mansfield  
California Highway Commission





The California Highway Commission subsequently approved this program.

The Forest Service later on refused to concur in the Auburn-Verdi project, but did concur in the other allotments.

As matters stand at the present time, therefore, there remains \$200,000 unallotted in the forest highway fund, which is available for allotment at the present time. The forestry officials desire that this \$200,000 be expended on roads other than the state highway system. The California Highway Commission has refused, however, to approve the allotment to any roads other than such as are on the seven per cent system, but the Commission is not insisting that it be applied to the Auburn-Verdi project. In fact, a subsequent request was made that this amount be applied towards completing the state highway into the Yosemite Valley by way of El Portal on the route from Mariposa, but the forest officials have refused to concur in this recommendation. The matter is now in the hands of the Secretary of Agriculture for decision.

On request of the U. S. Bureau of Public Roads and under the rules and regulations of the Secretary of Agriculture for administering forest roads and trails under the provisions of the Federal Highway Act, the California Highway Commission on October 5, 1922, approved and submitted to the bureau a map of the roads within and adjacent to the National Forests, which in its judgment should be included in the forest highway system as of primary importance to the state, counties, or communities thereof. There were designated 1200.16 miles in the forest highway system. All were on the state highway system and were in or adjacent to the National Forests as shown by the following table:

#### FOREST HIGHWAY SYSTEM.

Route	Description	Length miles
1	Crescent City to Oregon line.....	43.0
11	Placerville to Nevada State line.....	61.3
12	El Cajon to Jacumba.....	60.41
15	Route 1 near Calpella to east boundary Lake County....	61.51
15	Nevada City to Route 37 near Cisco.....	24.03
18	Mariposa to Yosemite National Park.....	30.67
20	Three Rivers to Douglas City.....	73.40
21	Pulga to Quincy.....	55.33
23	Saugus to Palmdale.....	37.55
23	Red Rock to Bridgeport.....	242.51
28	Adin to Oregon line.....	81.30
29	Paynes Creek to Susanville.....	85.50
37	Auburn to Nevada line near Verdi.....	97.3
43	San Bernardino end county pavement to Big Bear Lake..	38.0
57	Santa Maria to Maricopa.....	82.85
57	Bakersfield to Freeman.....	86.90
63	Big Pine to Oasis.....	38.6
Total .....		1,200.16

#### TRAFFIC REGULATION.

Owing to the damage which is being done to the state highways by overloaded motor trucks and heavily loaded trucks traveling at excessive rates of speed, the Commission felt it necessary to place deputies in the field for the purpose of apprehending violators of the Motor Vehicle Act with respect to overloads.



Plate XLVI. State Highway, Siskiyou County, use of longitudinal float in finish of concrete base.



Plate XLVII. State Highway, Siskiyou County, completed concrete base.



Major C. L. J. Frohwitter, a retired regular Army officer, was employed as superintendent of traffic regulations, and beginning in December, 1921, five traffic regulation crews were placed in the field in different parts of the state.

The work was continued with marked success until August, 1922, at which time all work of this nature was suspended because it was stated that the Attorney General's office had given its opinion that it was illegal for the Superintendent of the Motor Vehicle Department to designate as field deputies any one not an employee of the Motor Vehicle Department. It is absolutely essential that the men engaged in this work be deputized as field deputies or peace officers, in order that they may have authority to stop and weigh trucks and to make arrests when necessary.

In Appendix H will be found a description of the work done by the traffic regulation crews under Major Frohwitter.

#### **TRAFFIC CENSUS.**

A census of the traffic on the California state highways is now being conducted by the United States Bureau of Public Roads in cooperation with the California Highway Commission.

A similar census was made by the Bureau of Public Roads in 1920, at the time that this agency was making a study of road conditions in California.

The work at present under way is being prosecuted on a much more extensive scale, however, than in 1920 and will cover a period of six months. There has been appropriated by the California Highway Commission \$25,000 for the purpose and this appropriation will be matched by an equal amount of government funds.

#### **RAILROAD AND HIGHWAY GRADE CROSSING SEPARATIONS.**

The work of constructing grade crossing separations on the state highways of California is proceeding as rapidly as funds will permit. To date 163 separations have been made on the state highway system since work was started in 1912.

In order that this work may be prosecuted intelligently, a complete survey of the situation is now being made by the U. S. Bureau of Public Roads, the California State Railroad Commission and the California Highway Commission, in cooperation, and the results of this survey should be available before the end of 1922.

#### **CONCLUSION.**

Once more it is a pleasure to record the faithful, efficient and loyal services of the corps of assistants reporting to the State Highway Engineer and particularly to testify to the able and conscientious service of Mr. Thos. E. Stanton, Assistant State Highway Engineer, who has borne the brunt of the direction of the engineering work of the Commission since it was reorganized in 1921.

Respectfully,

A. B. FLETCHER,  
State Highway Engineer.

## APPENDIX B.

## LEGAL DEPARTMENT.

By CHARLES C. CARLETON, Attorney.

The writer during the last biennium has continued to handle the several lines of activities entrusted to him in 1911 at the time of the organization of the Commission, namely: right of way, claim, legislative and legal.

The counties, in pursuance of the policy adopted by the Commission early in state highway operations, have rendered invaluable aid to the state highway enterprise in acquiring by donation, purchase, dedication and condemnation the bulk of the rights of way needed for the state highway system.

The writer has endeavored to assist the local District Attorneys in the preparation of necessary condemnation proceedings to the fullest possible extent. Fortunately, the element of time being considered, most of these cases have been settled out of court.

However, condemnation proceedings for the acquisition of state highway rights of way in most of the contested cases have not been permitted to delay construction work indefinitely, as advantage has been taken of section 14, article I of the constitution of California, many orders for immediate possession of the rights of way sought to be acquired having been obtained and money deposits made into court to secure the defendant land-owners pending actual trials and final judgments.

Singularly, during the last two years a large proportion of the court opposition to the Commission's locations and to the state's acquisition of necessary rights of way therefor has centered in Los Angeles County on the proposed Coast highway extending between Oxnard, in Ventura County, and San Juan Capistrano, in Orange County (created by the \$40,000,000 state highway bond measure in 1919 and now in course of construction).

Deputies Attorney General Arthur Keetch and John Maltman of the Los Angeles branch office have borne the brunt of the contests in these cases with signal success to the state.

Several times orders of possession have been obtained by them on this route only one jump ahead of the contractor's steam shovels and the state highway work has thus been enabled to proceed without delay.

One interesting development of late in the state highway right of way work has been the constantly growing disposition of owners of timber tracts to donate standing timber along with the state highway rights of way, thereby insuring the maintenance of pleasing tree-bordered highways for the comfort and enjoyment of this and succeeding generations.

Additional ground for public parks and camp sites along the state highway system are also being obtained wherever practicable.

Claims of contractors against the state and claims of third persons against state highway contractors have absorbed much of the time of the legal department.

All claims of the contractors against the state have been adjusted satisfactorily to all concerned without recourse to the courts during the last two years.

Claims of third persons against state highway contractors, while very numerous, have also been settled in most instances outside the courts.

The legislature of 1919 much clarified the procedure in the prosecution of claims of creditors against state highway contractors, prescribing definite time limits for the commencement of such actions.

Theretofore the Commission felt itself obligated, through abundance of caution, to withhold contractors' moneys when claims were filed against the contractors in order to answer to such claims for as long as four years, which, of course, caused considerable embarrassment to contractors when claimants were dilatory or spiteful in properly following up their claims.

Now suits must be commenced within the much shorter period fixed by the 1919 legislature, thereby resulting in the claims filed on any particular contract being marshalled and disposed of in a much more expeditious manner than formerly.

The writer's efforts in the 1921 legislature were mainly devoted to the preparation of a gasoline tax measure in order to provide additional revenues for state highway betterments and of a set of amendments to the Motor Vehicle Act, designed to somewhat further reduce permissible weights of vehicles and loads on the highways and to obtain increased taxes from motor trucks and stages more in proportion to their actual use and abuse of the highways.

But owing to circumstances over which the Commission had no control, both these measures failed of final adoption.

An act of great importance to the Commission, chapter 58, Statutes of 1921, amending section 588 of the Penal Code, was prepared by District Attorney H. W. McGowan of Glenn County and the writer and passed by the legislature.

The evil of landowners flooding the highways with rice and other irrigation waters had become flagrant and immeasurable damage was being done to the highways of California.

The above section of the Penal Code, as now amended, provides public prosecutors with a direct and effective legal instrument to punish such offenders.

The writer has appeared for the Commission in a number of special matters before the Railroad Commission and other public boards and officials, federal, state, county and municipal, during the past two years.

The Railroad Commission has manifested in recent grade separation cases decided by that body an evident intention of requiring railroad corporations to bear their rightful share of the cost thereof, even though the new highway overhead crossing or subway, as the case may be, is located some distance from an existing grade crossing, and even though the existing grade crossing can not be entirely abandoned.

In other words, the Railroad Commission is taking the position that where a new state highway crossing structure will separate the highway and railroad grades and will actually handle practically all of the traffic in its particular vicinity, the railroad corporations should contribute toward the cost thereof despite the fact that existing grade crossings in



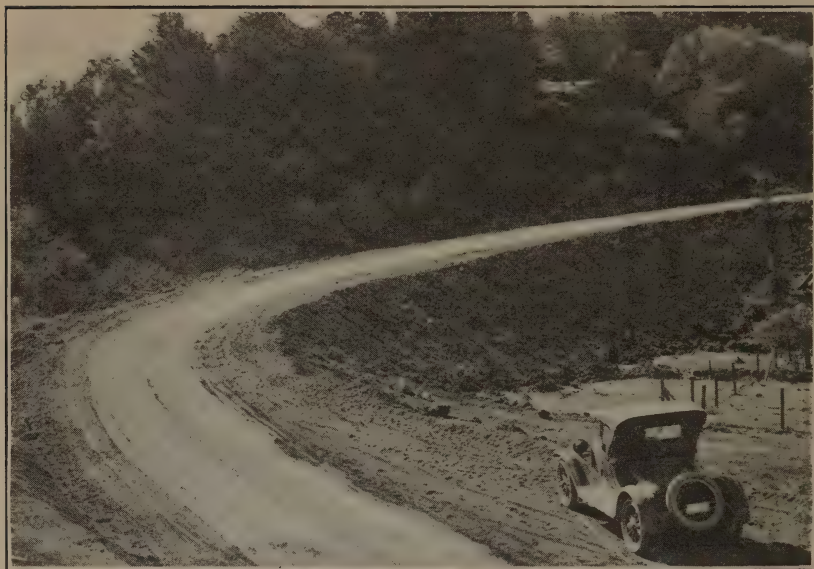


Plate XLVIII. State Highway, Mendocino County, completed graded roadway.

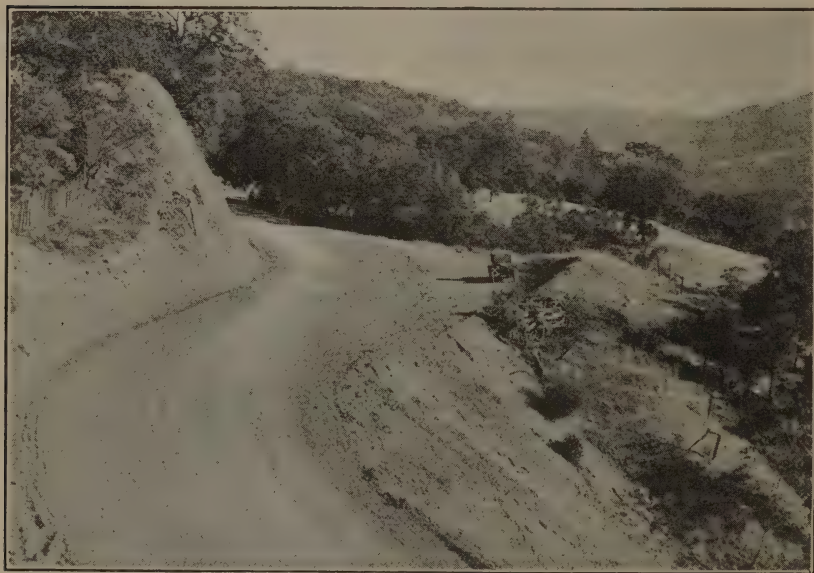


Plate XLIX. State Highway, Mendocino County, completed graded roadway.

the neighborhood can not be completely closed to all public highway use.

In addition to the other activities herein mentioned, the routine work of the legal department, such as the preparation and examination of contracts, bonds, deeds, assignments, releases, resolutions, notices and other papers, the rendering of opinions on the many questions arising pertaining to the state highway operations, the searching of land titles, the adjustment of right of way and other controversies, is ever increasing in volume, all combining to require the writer to continue to devote his time, as in the past, exclusively to the service of the state.

Among the court cases arising during the last two years, in which the Commission has been directly interested, may be cited the following:

*Hueneme, Malibu and Port Los Angeles Railway vs. A. B. Fletcher, California Highway Commission et al.* (No. 107302, Superior Court of Los Angeles County.) An injunction proceeding to restrain the defendants from constructing a certain portion of the Coast highway north of Santa Monica in Los Angeles County.

The court refused to grant an injunction and plaintiff has appealed to the Supreme Court of California, where the case is now pending.

*Crocker-Huffman Land and Water Company vs. State Department of Engineering* (Superior Court of Merced County). An injunction proceeding to restrain the state and its contractors from excavating certain ditches along a section of state highway under construction in Merced County. Settled out of court.

*W. H. Goff vs. United States Fidelity and Guaranty Company, Fred Hoffman, State of California et al.* (No. B-97589, Superior Court of Los Angeles County.) An action commenced in an endeavor to collect the claim of a subcontractor against a state highway contractor. Closed in so far as the state is concerned.

*In the Matter of J. E. Lee, Bankrupt* (District Court of the United States for the Southern District of California). This proceeding related to the distribution of funds in the hands of the California Highway Commission among the assignees and creditors of J. E. Lee, the original contractor on a state highway contract in Merced County. Closed.

*Robert F. Jones vs. Southern Pacific Railroad Company, California Highway Commission et al.* (No. B-98491, Superior Court of Los Angeles County.) Action which contests claim of state authorities to certain state highway right of way on Coast road, Los Angeles County.

*In the Matter of the Northern California Construction Company, Alleged Bankrupt* (No. 12406, District Court of the United States, Southern Division of the Northern District of California). An action still pending to determine financial status of a state highway corporate contractor which is now completing a state highway contract in Tuolumne County.

*The People of the State of California vs. Robert F. Jones et al.* (No. 105355, Superior Court of Los Angeles County.) Condemnation proceeding still pending for state highway right of way on Coast road, Los Angeles County.

*S. H. Mitchell vs. Wm. D. Stephens and others as the Advisory Board of the State Department of Engineering et al.* (District Court of the United States, Southern Division of the Southern District of California.) Action still pending arising out of the use of certain federal aid moneys to facilitate the sale of certain state highway bonds.



Plate L. State Highway, Sonoma County, completed concrete base.



Plate LI. State Highway, Fresno County, completed concrete base near Coalinga.



*People of the State of California vs. Southern Pacific Company* (No. 110326, Superior Court of Los Angeles County). Condemnation proceeding still pending for certain state highway right of way near Santa Monica in Los Angeles County.

*American Indemnity Company vs. Northern California Construction Company, California Highway Commission et al.* (No. 125673, Superior Court of the City and County of San Francisco.) An injunction proceeding. Dismissed.

*People of the State of California vs. Title Insurance Company* (No. 108032, Superior Court of Los Angeles County). Condemnation proceeding still pending for certain state highway right of way on Coast road north of Santa Monica in Los Angeles County.

*Ocean Shore Railroad Company vs. Spring Valley Water Company, State of California et al.* (No. 8831, Superior Court of San Mateo County.) An action to quiet title. Many years ago the Spring Valley Water Company conveyed a railroad right of way to the Ocean Shore Railroad Company. The Railroad Company has ceased operations of its railroad but still claims title to the strip of land originally deeded to it by the Spring Valley Water Company.

The Spring Valley Water Company and the State of California, the former having recently conveyed a portion of the strip of land in dispute to the state for state highway purposes, claim that when the railroad right of way ceased to be used for railroad purposes it reverted to the Spring Valley Water Company and its successors in interest. Trial will be held before end of year, 1922.

*B. B. Hutson vs. Frank Johnson, California Highway Commission* (Superior Court of Mendocino County). An action on a withhold notice.

*Scott W. Alexander vs. A. B. Fletcher, Director of Public Works, and California Highway Commission* (No. B-97442, Superior Court of Los Angeles County). In this case an important decision was rendered by Superior Court Judge J. Perry Wood of Los Angeles County in favor of the California Highway Commission.

For the first time in the history of the Commission an attempt was made through the medium of a court to set aside the determination of the Commission in the selection of a route for a state highway.

The suit was brought by a resident of Long Beach to compel the Commission to build the particular portion of the proposed Oxnard-San Juan Capistrano state highway lying between Long Beach and Seal Beach immediately along the shore between these points instead of slightly inland from the shore, the latter location having been decided by the Commission to be the more economical and practical one to be followed.

By choosing the inland route the Commission avoided the necessity of constructing two expensive bascule bridges over inlets of the sea and avoided serious right of way difficulties.

Judge Wood held that the choosing of the route rested entirely within the discretion of the Commission, that the court could not interfere unless bad faith was shown, and that the plaintiff had failed to establish this.

Thereupon Judge Wood ordered that judgment of non-suit be entered against the plaintiff.

## APPENDIX C.

## MOTOR LUBRICATING OILS.

By THOS. E. STANTON, Assistant State Highway Engineer.

Owing to the large number of motor trucks and other motor vehicles operated by the California Highway Commission, the Division of Highways is an extensive purchaser of lubricating oils.

The trucks especially are frequently operated under trying conditions and therefore the elimination of any factor which adversely affects the condition of the motor is of considerable importance.

The most common source of supply from which motor lubricating oils are secured is crude petroleum.

The chief fields producing crude petroleum in America are located in Pennsylvania, the central United States, California and Texas. The base of the Pennsylvania and other northern and eastern crudes is paraffine, whereas the base of the Gulf and California crudes is almost universally asphalt. The finished oils from these two classes of crudes are referred to as paraffine base and asphalt base oils.

The viscosities of asphalt base oils are subject to a rapid decrease as the temperature of the oil is increased. An asphaltic base oil may have a viscosity from two to three times as high as a paraffine base oil at 100° F., but when the two oils are compared at a temperature of 210° their viscosities will be found to be approximately the same. See Fig. 1 showing viscosity curves for heavy and extra heavy California asphaltic base and paraffine base oils.

This fact makes it necessary to select an asphalt base lubricating oil from its viscosity at the desired working temperature of the bearing, as the viscosity at 100° F. frequently used to indicate the body of the oil is no absolute indication of its viscosity at working temperature.

Starting with oils of equal viscosity at 100° F. the asphalt base oil, thinning out so much more rapidly than the paraffine oil, causes the impression that the oil loses its lubricating qualities and also that it breaks down under high temperatures with, it has been claimed, the resultant formation of free carbon. As the California asphaltic base oils are considerably cheaper than the imported Eastern paraffine base oils, the determination, if possible, of the relative merits of the two grades was considered of such importance that a series of tests was carried on by the Commission during the summers of 1921 and 1922 in an effort to determine the relative merits of some of the principal brands of the lubricating oils on the market.

In one portion of California a paraffine base oil is produced, thus giving an opportunity to compare two oils made from California crudes, one with a paraffine base and one with an asphalt base.

*Test No. 1.*

Six trucks which had been secured as excess war equipment from the United States government, and which were practically new, having been operated less than 100 miles, were used in the conduct of the test. The

truck units were as nearly identical as practicable, having the same make of engines, magnetos and carburetors.

Three brands of oil manufactured by well known reliable manufacturers were used in the tests; one a well known Eastern paraffine base oil, one a California paraffine base oil and one a well known California asphalt base oil; two trucks to each brand of oil.

The test was carried on at the California Highway Commission testing laboratory on the State Fair grounds, Sacramento. The trucks were blocked up so that the wheels were free from the ground. They were then serviced with gasoline and with the oils which it was desired to test, set in high gear and run continuously at a truck speed of ten miles per hour, eight hours per day for ten consecutive days.

Before starting the test the crank case was drained and filled with new oil. After running the motor for a few minutes, the oil was drained off and the case again filled with a measured amount of fresh oil to the proper level of the oil gauge.

The trucks were equipped with two thermometers and an oil pressure gauge. One thermometer was placed in the water line between the motor and the radiator, the other being attached to the crank case in order to record the oil temperatures. The pressure gauge was attached to the oil feed line.

At the beginning and also at the completion of each day's run the compression in each motor cylinder was measured. The oil temperature, oil pressure, water temperature, atmospheric temperature and mileage readings were taken each hour.

At the end of each day's run the trucks were serviced with fresh oil and gasoline without removing the old oil, a record being kept of the oil used. Every second day a pint of oil was drawn from each crank case and set aside for test.

Upon completion of the ten-day run the oil was drained from the crank case, the motor was torn down and an inspection made of the bearings, etc. All carbon was removed from the piston heads, cylinders and valves and weighed.

A second run of ten days was then made with the two California oils, the paraffine base oil being used in the truck originally operated with asphalt base oil and vice versa.

Samples of the fresh and used oils were then sent to the chemical testing laboratory of the Commission in Sacramento and to the Bureau of Standards in Washington, D. C.

Viscosity, cold, flash and fire tests were made at the Sacramento laboratory.

The Bureau of Standards made tests to determine the grade of the oils, gravity, flash, fire, viscosity, pour, Conradson carbon, Waters carbonization, demulsibility, sediment, water and ash.

The viscosity tests at Sacramento were made at both high and low temperatures. For the high temperature viscosity tests the Saybolt viscosimeter and 60 c.c. viscosimeter flask was used.

In obtaining the viscosities at low temperature it was necessary to have an air-tight bath and an instrument which had a larger orifice than the Saybolt. A Tagliabue viscosimeter was modified by insulating the bath with asbestos, which was then shellacked. The cold water was run into



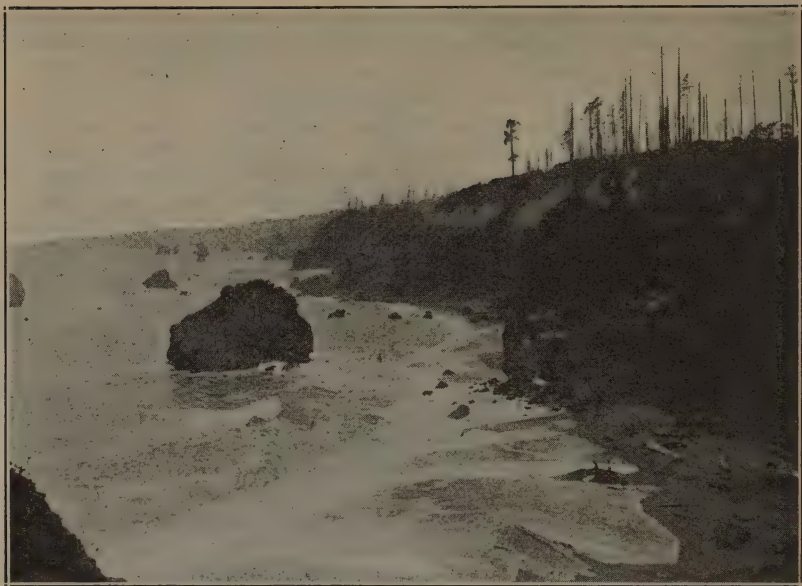


Plate LII. State Highway along the coast in Del Norte County.



Plate LIII. State Highway, through the redwoods in Del Norte County.

the bath from above at a rate that would give the outflowing water a temperature two degrees above the required temperature, whereas the mixture of ice and water when run in from the reservoir was about two degrees below the required temperature. This procedure was found to give the best results in maintaining the oil to be tested at the proper temperature while in the cup.

In taking the readings the ordinary spout of the viscosimeter was not used, the outlet tube being used without reduction in size.

This method was used in order to compare the oils at such low temperatures that the ordinary Saybolt viscosimeter could not be used.

### *Results Secured from Test No. 1.*

The Eastern and the California "paraffine" base oils were definitely determined by the Bureau of Standards to have been manufactured from a crude, relatively high in paraffines, whereas the other California oil was determined to be from a naphthene base crude.

The following table shows the gasoline and oil consumption and the amount of carbon formed:

TABLE SHOWING GASOLINE AND OIL CONSUMPTION  
AND CARBON DEPOSIT.

Test No. 1.				
Oil used	Truck No.	Total carbon grams	Miles per quart oil	Miles per gallon gasoline
Eastern paraffine base-----	814	108	32.88	7.15
	810	95	99.81	6.65
Average -----		101	66.35	6.90
California paraffine base-----	801	86	88.49	7.41
	799	88	69.23	7.04
	806	74	107.53	6.73
	819	105	58.49	6.85
Average -----		88	80.93	7.01
California asphalt base-----	806	52	116.87	6.36
	819	57	71.33	6.67
	801	96	54.83	7.35
	799	89	37.37	8.11
Average -----		73	70.10	7.12

A close study of the above table does not indicate any marked superiority of one oil over the other.

While the asphalt base oil shows the least carbon and highest average gasoline mileage of the three oils tested, the oil consumption favors the California paraffine oil.

Though the averages are close, the wide range between different trucks where the same oil is used is a practical demonstration of the difficulty of securing identical operating conditions with two trucks or with the same truck after overhauling. Carburetor and other adjustments undoubtedly have a marked effect on the results. Where the results when operating under close control show such a marked variation and yet do not show any decided advantage in favor of any one oil when the average figures are compared, it can readily be seen how impossible it is for

the average operator to arrive at any intelligent comparison when operating under the usual working conditions.

Fig. 2 shows the viscosity curves for the three oils.

At 70° it will be noted that the California paraffine base oil (heavy) showed a viscosity of about 700, or less than one-third the viscosity of the asphaltic base oil. At 250°, however, the viscosity was the same.

Figs. 3 and 4 show the viscosity of samples of used oil taken at the end of four and ten days.

It will be noted that the relative viscosity is maintained throughout and that the asphalt base oil did not lose its viscosity through use more rapidly than the paraffine base oils.

The results secured by the Bureau of Standards checked very closely with the results secured at the Highway Commission laboratory in Sacramento.

Fig. 5 shows the modified Tagliabue viscosity curves for temperatures between 30° and 100°.

One interesting result shown by these curves is that while the viscosity of the asphalt base oil increases very rapidly with a drop in temperature from 100° to 46°, below 46° the viscosity of the California paraffine base oil increases so rapidly that the two oils show practically the same viscosity at 40°. Below 40° the paraffine base oil hardens very rapidly until it reaches the cold or freezing point at 25°, whereas the freezing point of the asphalt base oil was found at approximately 10° F. by the modified Tagliabue viscosimeter used in the test.

The three oils gave practically the same flash and fire tests.

The temperature of the motors and of the oil in all trucks during operation was approximately the same and the motors were all found to be in practically the same condition when examined after the test run.

### *Test No. 2.*

In order to meet the objection that Test No. 1 had not been conducted under actual field operating conditions where either the load or the grades and surface of the road are such as to require the use of low gear for long distances, two three-ton trucks, similar in make and condition, one using an asphaltic and the other a paraffine base oil, were loaded with three tons of supplies and sent on a round trip over the Sierra Nevadas from Sacramento to Alpine County and return, the load being left on the work in Alpine County.

On the first day of the trip heavy pulls were encountered between White Rock and Placerville, a large portion of the distance being made in second with an occasional use of low gear.

The second day developed a great deal of heavy pulling, second and low gear being used most of the time.

The third day of the trip developed the hardest pulls, the first three miles being through sand, all second gear work; the next six or seven miles being a steady up-hill climb, all second or low gear.

The balance of the trip was fairly easy going.

In general the trip was well routed for the purpose, as many steep and long grades were encountered. The first three days the trucks were worked hard and the water kept boiling about three-quarters of the time.



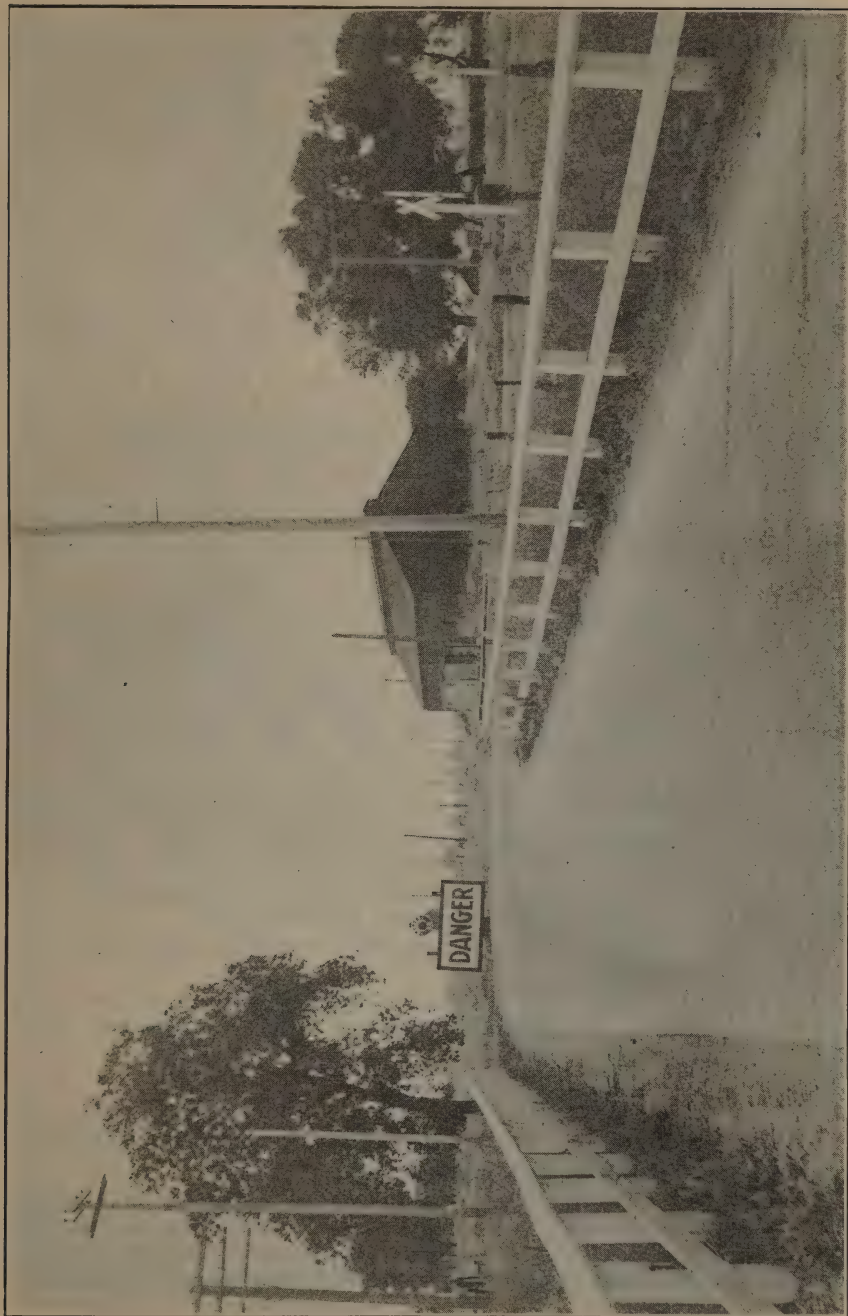


Plate LIV. State Highway, Sutter County, showing warning signal and sign at Lomo crossing.

Following is a tabulation of the results secured :

Truck No.	Gross weights	Miles traveled	Oil	Oil used quarts	Gas. gals.	Carbon grams	Temp. of oil	
							Low	High
814	14,519 lbs.	331.5	Asphalt base----	14.5	98	65	60°	180°
819	14,525 lbs.	331.5	Paraffine base--	14.0	97	78	60°	190°

No. 7 asphalt base and heavy paraffine base oils were used.

### *Test No. 3.*

In order to ascertain the relative action of the two types of oils under the extreme heat conditions prevailing in the Imperial Valley, a third series of tests was made during the latter part of May, 1922, with trucks engaged in hauling construction materials for a section of concrete pavement being constructed by day labor several miles west of Westmoreland.

A heavy paraffine base oil and No. 7 and No. 9 asphaltic base oils were used. The trucks used had already been through a season of hard work and would have been in the shop for repairs had it not been necessary to use all equipment available and exert every ounce of energy to complete the work before the extreme heat of summer. The roads hauled over were practically impassable.

Eight three and one-half-to five-ton trucks were used in the test, four using the paraffine base oil, two asphalt base No. 7 and two asphalt base No. 9.

Before filling the trucks with fresh oil, the crank cases were drained and cleaned with a flushing oil. After the trucks were serviced they were run between the railroad siding at Westmoreland and the mixer, a distance of about seven miles each way, delivering to the mixer four and one-half tons of concrete material and returning unloaded. The route was for the greater part through sand with considerable hard pulling, mostly second and third gear work. The atmospheric temperature during the test varied from 104° to 118°. After the trucks had been run long enough to obtain the desired records, they were drained of oil, flushed and refilled with new oil, the trucks originally using the paraffine oil being now filled with asphalt oil and vice versa; except one truck which had been dropped on account of a stripped worm gear and one other truck which was allowed to run without change.

The results of this test did not show any appreciable difference in the value of the oils used.

The consensus of opinion among the truckdrivers favored the No. 9 asphaltic base oil. The quantities consumed were approximately equal for each grade of oil.

### *Conclusions.*

The net result of all three tests did not indicate any appreciable superiority in either grade of oil over the other.

Although thinning out more rapidly, the asphaltic base oil did not show any greater breaking down under high working temperatures than the paraffine base oil, nor was there a greater deposit of carbon. Neither did the viscosity after use increase or decrease any more in the case of one than the other.

Where one grade of oil is used all seasons of the year and under a wide range of temperature there appears to be some practical advan-

tages in the use of the paraffine base oil, as for normal temperatures above 40° this oil is less stiff and therefore it is easier to start the motor in cold weather than with an asphaltic base oil of the same viscosity at working temperatures.

There appears to be no reason, however, why a lighter grade of asphaltic base oil can not be used in cold weather than in hot weather and why, if a proper selection is made based on weather and working conditions, there should be any practical difficulties with this grade of oil.



VISCOSITY TABLE

Temperature Fahr	California Asphaltic Base "7"	California Asphaltic Base "9"	California Paraffin Base (Heavy)	California Paraffin Base (Ex-Heavy)
100°	553 sec.	1390 sec	306 sec.	437 sec.
150°	134 "	236 "	129 "	155 "
210°	53 "	75 "	53 "	69 "

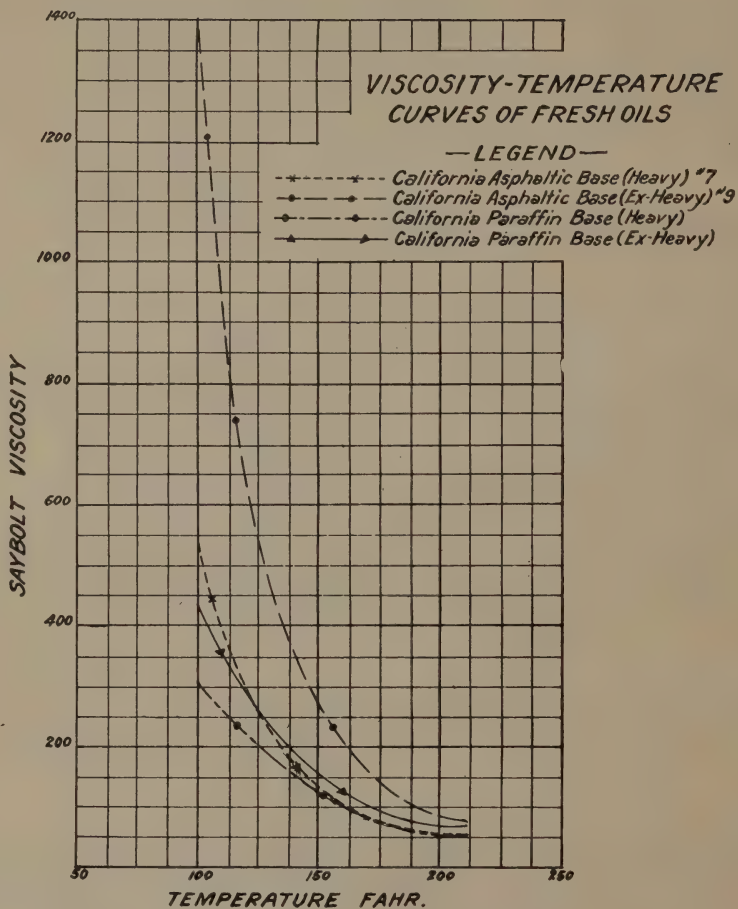
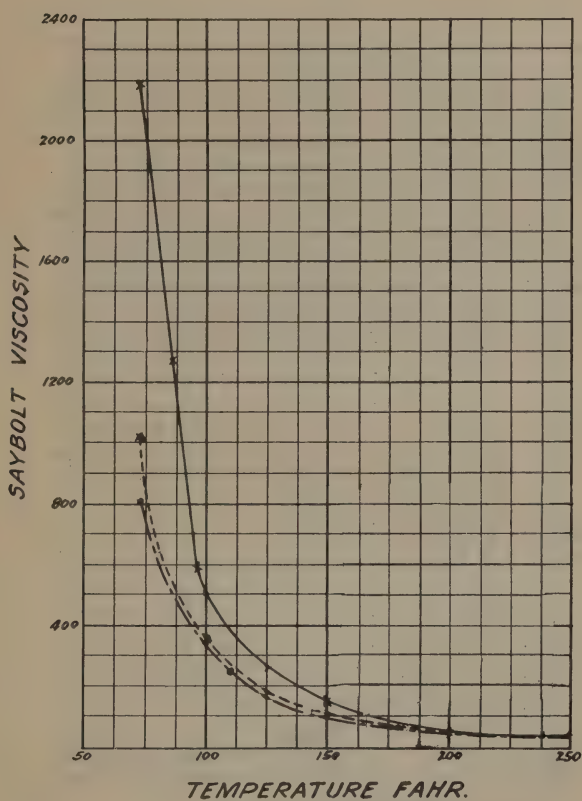


Fig-1

### VISCOSITY-TEMPERATURE CURVES OF FRESH OILS

#### — LEGEND —

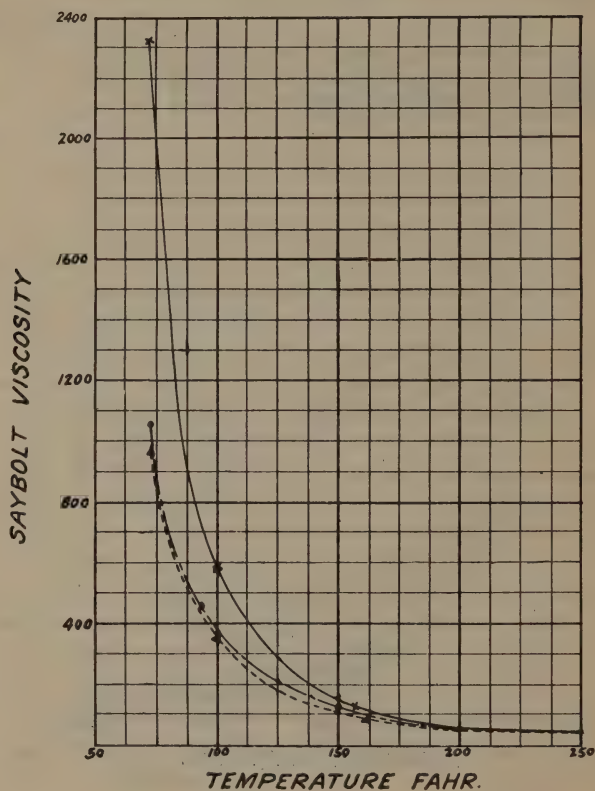
- \*—\* California Asphaltic Base (Heavy)
- California Paraffin Base (Heavy)
- Eastern Paraffin Base (Heavy)

*Fig-2*

### VISCOSITY-TEMPERATURE CURVES OF FOUR DAY USED OILS

#### —LEGEND—

- \*— California Asphaltic Base (Heavy)
- California Paraffin Base (Heavy)
- ▲— Eastern Paraffin Base (Heavy)

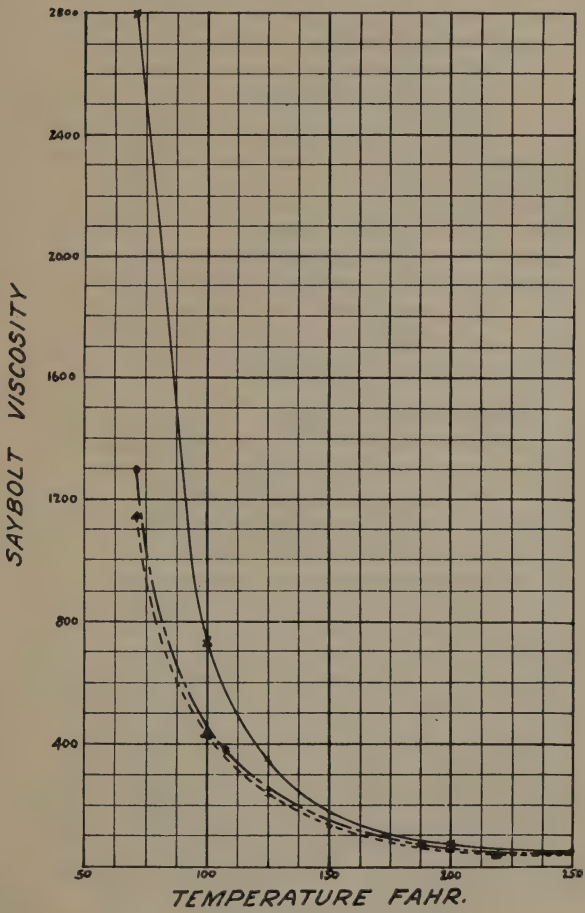
*Fig-3*



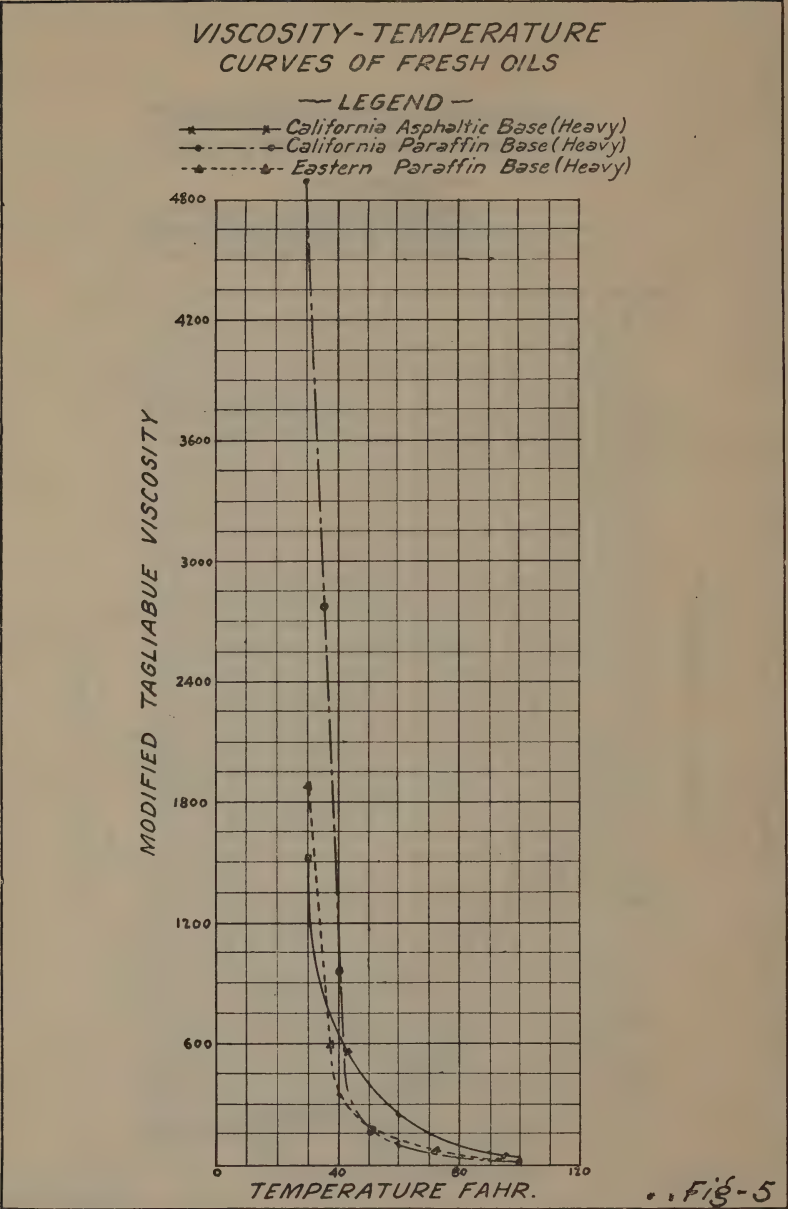
**VISCOSITY-TEMPERATURE  
CURVES OF TEN DAY USED OILS**

**— LEGEND —**

- ▲— California Asphaltic Base (Heavy)
- California Paraffin Base (Heavy)
- ▼— Eastern Paraffin Base (Heavy)



*Fig-4*



## APPENDIX D.

## EQUIPMENT AND SHOPS.

By R. H. STALNAKER, Assistant Highway Engineer.

**EXCESS WAR MATERIAL.**

At the close of the World War, the federal government had on hand an enormous quantity of equipment, machinery, and supplies, much of which has been distributed to the State Highway Departments of the several states, under the provisions of three acts of Congress; the Post Office Appropriation Act of 1919, the so-called Kahn Bill of 1920, and the Federal Highway Act of 1921. All three of these bills provide for the distribution of the material upon the same basis as that provided for federal aid roads. The Post Office Appropriation Act of 1919 and the Federal Highway Act of 1921 required the states to pay the cost of packing and loading this material and the freight on the same, while the Kahn Bill provided that the states were to pay to the government 20 per cent of the estimated value of all material distributed under it, but also provided that the freight paid on such material might be deducted from such payments. However, under this bill both the charges and freight allowances are cumulative, and, in the case of California, on account of the long freight hauls on most of the material and the large quantity of heavy material of low intrinsic value, the total freight paid will probably exceed the 20 per cent valuation, so that, as a matter of fact, the total cost of this material will only be the freight and handling charges.

Under the provisions of these three acts, California had, up to June 30, 1922, received 884 trucks, 70 automobiles, other than Fords, 84 Fords, 121 motorcycles, several carloads of automobile and truck parts, three carloads of shovels, two of railroad picks, one of pick handles, several carloads of machine tools and road machinery, 300,000 yards of canvas of various weights, 1,750,000 pounds of T. N. T., hand grenade, and black blasting powder, and large quantities of other equipment and material, the total original cost to the government of which is stated by the United States Bureau of Public Roads to be approximately \$4,463,000. Much of the equipment, however, was received in a used condition and its actual value at time of delivery was much below the original cost.

The total payments for freight, loading charges, etc., on this material to June 30, 1922, aggregate approximately \$250,000.

During the past biennium a considerable number of used motor vehicles have been taken over at the various army posts in this state, many of which were practically worn out and only valuable as a source of spare parts. Such of these vehicles as are not worth repairing are being dismantled and all usable parts placed in stock for issue as required.

The Kahn Bill provides for the leasing by the states to the counties and other governmental subdivisions, for use in the construction and maintenance of public roads, of motor vehicles and other excess war





Plate LV. California Highway Commission Shops, Sacramento.

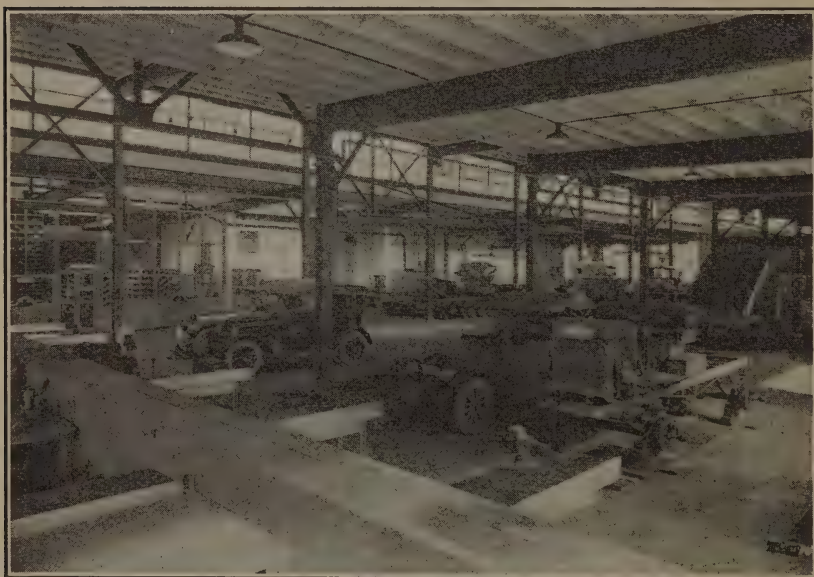


Plate LVI. California Highway Commission Shops, Sacramento.



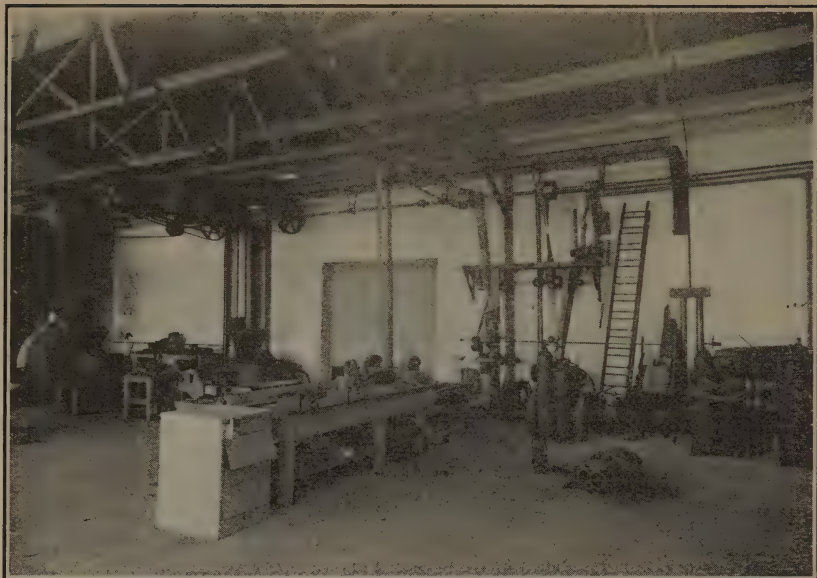


Plate LVII. California Highway Commission Shops, Sacramento.

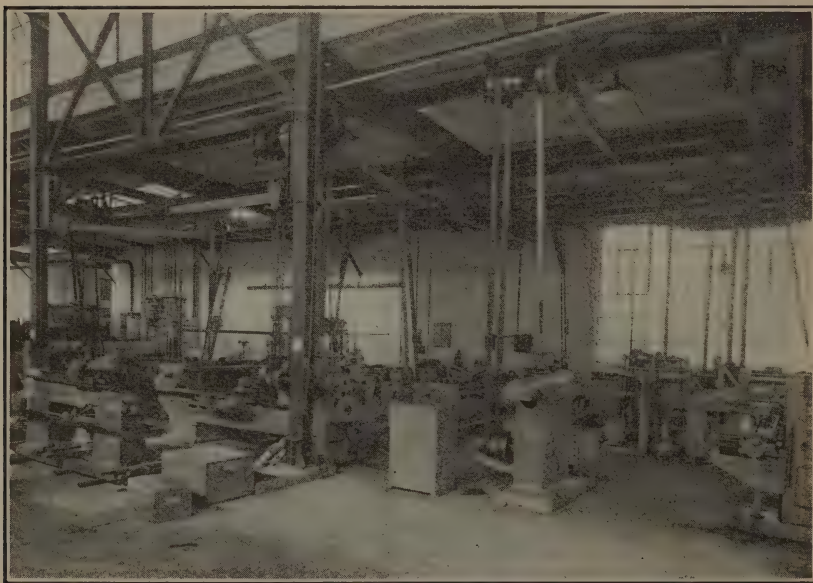


Plate LVIII. California Highway Commission Shops, Sacramento.



material, and under the provisions of this act the Commission has made three trucks available to each county, and practically all the counties have leased trucks under these offers.

#### SHOPS AND MAINTENANCE YARDS.

In order to house and care for the trucks and equipment allotted the several divisions and to facilitate the issuance of tools and materials as needed, division shops and warehouses have been established at Willits, Redding, Fruitvale, Petaluma, San Jose, San Luis Obispo, Fresno, Bishop and Lankershim, and a central shop and warehouses established at Sacramento.

The several division shops have been equipped with machinery and tools necessary for making routine repairs and the headquarters shop at Sacramento is fully equipped for the overhauling of all the equipment of the Commission. Nearly all the machinery and tools needed to equip these shops were received from the federal government.

The headquarters shop and warehouses are located on both sides of Thirty-fourth street, between R street and Serra Way, Sacramento. A spur track from the R street line of the Southern Pacific provides shipping facilities.

The shop is a one-story brick building, well lighted, and covering a floor area of about 26,000 square feet. It is completely equipped for the repair of all classes of equipment, and is one of the most complete shops of this nature in the state. The machine shop equipment includes three lathes, a planer, crankshaft grinder, cylinder grinder, universal and cutter grinder, five-foot radial drill, universal milling machine, hand milling machine, 28-inch sliding head drill, sensitive drill, tool grinders and other minor tools. The equipment of the blacksmith shop includes spring and felloe-band furnaces, heat-treating furnace, two down-draft forges, a hydraulic tire press, oxy-acetylene welding and cutting torches and other minor tools.

Two corrugated iron warehouses, each 60 x 140 feet, have been erected to house trucks and materials awaiting distribution, and a galvanized iron building on the west side of Thirty-fourth street, formerly occupied as a shop by the Commission, is now utilized as a warehouse for small tools and supplies.

In addition to these buildings, storage space in the city corporation yard and at the State Fair ground, has also been occupied through the courtesy of the officials in charge.

Prior to the distribution of surplus war material by the government, comparatively little equipment was owned by the Commission. As soon as it became apparent that a considerable quantity of equipment would be received from the government, an equipment department was organized at headquarters and the general charge of all equipment, as well as the distribution of supplies from government stock, placed in its custody.

This department is also in direct charge of the central repair shops at Sacramento, and exercises a general supervision over the use and repair of the equipment of the several divisions.

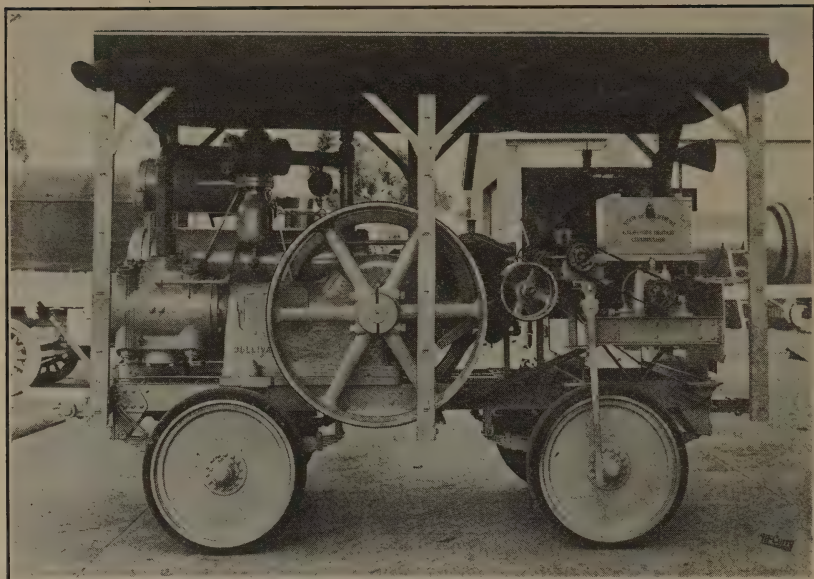


Plate LIX. Air compressor outfit for sand blasting and painting bridges assembled at the shops of the Highway Commission at Sacramento.



Plate LX. Complete air compressor outfit fully equipped.

## APPENDIX E.

ACCOUNTING DEPARTMENT AND  
FINANCIAL STATEMENT.

By H. B. WEAVER, Chief Accountant.

At the time the Department of Public Works came into existence, the accounting work of the different divisions of the department was brought under one head and to a considerable extent the work of the different divisions was made uniform.

In all divisions except one, the work was of such a nature that this could be done, but in the case of the Division of Land Settlement, many of the transactions were entirely different from those handled by the other divisions. Consequently, although part of the work was made uniform with the other divisions, much of it is yet handled by the local offices in the same manner as formerly.

The accounting work of the Division of Highways has greatly increased during the last biennium. By referring to the "Statement of Expenditures" on page number 118 it will be noted that the expenditures made under the direction of this Commission increased from \$9,279,623.91 in 1920 to \$14,144,741.83 in 1921. At the time of writing this report, it appears probable that the expenditures for the year 1922 will exceed \$18,000,000. In 1918, about 3000 claims were being audited and handled monthly by the accounting department; by 1920, the number had increased to approximately 4500, and at present, the number of claims being audited and handled is approximately 7000 per month.

During the biennium, federal aid was requested from the federal government to the extent of over \$3,000,000, and to support the vouchers for this amount it was necessary to render, in full detail, schedules of payments covering more than twice that amount.

Included in this appendix is the "Statement of Condition" of June 30, 1922, statements showing expenditures in the different counties, from the First, Second and Third State Highway Funds during the last two years, and the consolidated statement showing all expenditures made by this Commission since 1912.

In appendix "O" will be found a full statement of expenditures for maintenance, together with an analysis of such expenditures.

## STATEMENT OF CONDITION.

June 30, 1922.

(Recapitulation.)

*Assets.*

First State Highway Fund expenditures.....	\$18,002,129 00
Second State Highway Fund expenditures.....	14,876,882 42
Third State Highway Fund expenditures.....	18,710,116 47
Motor Vehicle Fund expenditures.....	11,902,862 76
Special appropriation expenditures.....	123,477 90
Expenditures, contributions by counties and cities.....	943,785 05
Expenditures Federal Aid.....	3,586,827 31
Discount on Third State Highway bonds.....	222,160 50
Cash on hand.....	109,911 19
Funds in treasury.....	7,601,158 05
Total assets.....	\$76,079,310 65



*Liabilities.*

55	Vouchers payable	\$620,019 07
57	First State Highway bonds	18,000,000 00
58A	Donations	945,399 24
60	Unclaimed wages (State Highway Fund)	2,286 47
60A	Unclaimed wages (Motor Vehicle Fund)	549 56
62	Motor Vehicle Fund apportionments	11,992,556 14
64	General appropriations, chapter 704, Acts 1915	7,321 86
65	General appropriations, chapter 708, Acts 1915	7,986 50
66	Premiums (First State Highway bonds)	2,129 00
67	Federal Aid road account	3,808,987 81
68	Appropriation, chapter 746, Acts 1917	250,000 00
69	Second State Highway bonds	15,000,000 00
70	Premiums (Second State Highway bonds)	25 00
73	Revolving Fund Reserve (First State Highway Fund)	100,000 00
74	Revolving Fund Reserve (Second State Highway Fund)	50,000 00
81	Revolving Fund Reserve (Third State Highway Fund)	50,000 00
75	Third State Highway bonds	24,000,000 00
78	Premiums (Third State Highway bonds)	1,134,550 00
80	Appropriation, chapter 888, Acts 1921	70,000 00
82	Appropriation, chapter 883, Acts 1921	30,000 00
83	Appropriation, chapter 832, Acts 1921	7,500 00
Total liabilities		\$76,079,310 65

## STATEMENT OF CONDITION.

June 30, 1922.

(Details.)

*Assets.*

First State Highway Fund expenditures:		
2	Highways in process	\$16,308,250 14
5	Sand plants	20,474 64
20	Construction equipment	\$18,255 04
21	Engineering equipment	18,914 43
22	Furniture and fixtures	17,038 04
23	Stable equipment	12,477 54
24	Automobile equipment	40,839 04
25	Camp equipment	4,744 67
26	Laboratory equipment	2,847 42
Total equipment		115,117 08
35	Store account	21,174 76
43	Headquarters expense	\$272,101 01
44	Divisions expense	372,381 08
72	County expense	892,630 29
Total expense		1,537,112 38
Total State Highway Fund (first) expenditures		\$18,002,129 00
Second State Highway Fund expenditures:		
2	Highways in process	\$13,090,659 28
202	Highways in process (new routes)	714 76
4	Office buildings	46 87
5	Sand plants	14,603 91
10	Maintenance yards	37,648 54
11	Powder magazines	12,289 50
20	Construction equipment	\$117,134 94
21	Engineering equipment	22,247 45
22	Furniture and fixtures	22,090 18
23	Stable equipment	5,306 36
24	Auto equipment	180,323 36
25	Camp equipment	19,523 35
26	Laboratory equipment	4,206 75
28	Shop equipment	915 87
Total equipment		371,748 26



Plate LXI. State Highway, Solano County, laying asphalt surface.



Plate LXII. State Highway, Solano County, showing widening and thickening, finishing asphalt concrete wearing surface.

35	Store account	82,609 60
40	Shop work in progress	20,262 60
41	Shop expense	6,282 87
43	Headquarters expense	\$252,035 18
44	Division expense	449,111 29
72	County expense	527,970 92
245	County expense (new routes)	
	Total expense	1,229,117 39
79	Other divisions	1,768 29
71	Motor Vehicle Fund charges on State Highway Fund schedules	9,130 55
	Total Second Highway Fund expenditures	\$14,876,882 42
Third State Highway Fund expenditures:		
2	Highways in process	\$14,705,143 27
202	Highways in process (new routes)	988,001 02
4	Office buildings	16,334 68
5	Sand plants	1,430 91
10	Maintenance yards	116,062 17
11	Powder magazines	384 36
20	Construction equipment	\$248,291 72
21	Engineering equipment	15,002 14
22	Furniture and fixtures	28,147 85
23	Stable equipment	2,175 88
24	Auto equipment	313,172 09
25	Camp equipment	53,039 82
26	Laboratory equipment	8,638 53
28	Shop equipment	15,637 54
	Total equipment	684,105 57
35	Store account	252,205 86
40	Shop work in progress	68,136 01
41	Shop expense	13,856 23
39	Bills vs. divisions	40,705 76
43	Headquarters expense	\$276,693 02
44	Divisions expense	428,430 54
72	County expense	387,430 12
245	County expense (new routes)	652,706 12
	Total expense	1,745,259 80
79	Other divisions	762 68
71A	Motor Vehicle Fund charges on State Highway Fund schedules	77,728 15
	Total Third State Highway Fund expenditures	\$18,710,116 47
Motor Vehicle Fund expenditures:		
103	Highway maintenance	\$10,882,426 94
105	Sand plants	8 75
107	Nursery site	15,399 00
110	Maintenance yards	255,411 54
111	Powder magazines	8,673 06
120	Construction equipment	\$306,061 34
121	Engineering equipment	155 13
122	Furniture and fixtures	1,220 47
123	Stable equipment	755 49
124	Auto equipment	202,819 52
125	Camp equipment	13,839 52
126	Laboratory equipment	56 25
128	Shop equipment	31,423 90
	Total equipment	556,331 62
135	Store account	70,162 70
140	Shop work in progress	33,810 30
141	Shop expense	7,426 02
145	County expense	59,703 32
146	Traffic census and regulations	9,161 08
147	Pittsburg test road	4,347 83
	Total Motor Vehicle Fund expenditures	\$11,902,862 76



## Special appropriation expenditures:

301	Chapter 704, Acts 1915: Los Angeles County-----	\$7,321 86
302	Chapter 748, Acts 1915: Ventura County-----	7,986 50
303	Chapter 746, Acts 1917: Klamath River Road-----	40,000 00
304	Chapter 746, Acts 1917: Trinity-Humboldt Extension-----	4,124 41
305	Chapter 746, Acts 1917: Oxnard-San Juan-----	12,934 61
306	Chapter 746, Acts 1917: Jackson's Ranch-Governor's Camp-----	3,033 01
307	Chapter 746, Acts 1917: Carmel-San Simeon-----	11,358 52
308	Chapter 746, Acts 1917: Carmel-San Simeon-Jolon connection-----	2,204 37
309	Chapter 746, Acts 1917: Dumbarton Bridge-----	2,240 71
310	Chapter 746, Acts 1917: Santa Maria-Cuyama-----	6,500 09
311	Chapter 746, Acts 1917: Huasna-Alamo-----	45 16
320	Chapter 888, Acts 1921: Alturas-Cedarville-----	25,728 75
321	Chapter 883, Acts 1921: Madera-Yosemite-----	-----
322	Chapter 832, Acts 1921: San Luis Obispo-School-----	-----
Total special appropriation expenditures-----		\$123,477 90

## Expenditures—contributions by counties and cities:

401	Expenditures Humboldt County contribution-----	\$120,229 87
402	Expenditures Shasta County contributions-----	64,000 00
403	Expenditures Siskiyou County contributions-----	55,499 71
404	Expenditures Glenn County contributions-----	15,021 52
405	Expenditures Contra Costa County contributions-----	3,056 93
406	Expenditures Marin County contributions-----	35,000 00
407	Expenditures Napa County contributions-----	65,000 00
408	Expenditures Sonoma County contributions-----	75,000 00
409	Expenditures San Luis Obispo County contributions-----	9,385 81
410	Expenditures Imperial County contributions-----	53,104 60
411	Expenditures Calaveras County contributions-----	20,000 00
412	Expenditures Mendocino County contributions-----	60,209 14
413	Expenditures Colusa County contributions-----	17,860 47
414	Expenditures Solano County contributions-----	5,000 00
415	Expenditures Mariposa County contributions-----	2,200 00
416	Expenditures Santa Barbara County contributions-----	113,715 75
417	Expenditures Kern County contributions-----	19,452 04
418	Expenditures Town of Niles contributions-----	2,143 86
419	Expenditures City of San Juan Bautista contributions-----	9,000 00
420	Expenditures City of El Cajon contributions-----	5,992 00
421	Expenditures Merced County contributions-----	2,707 88
422	Expenditures San Benito County contributions-----	2,000 00
423	Expenditures Tulare County contributions-----	1,997 54
424	Expenditures Yolo County contributions-----	6,737 12
425	Expenditures El Dorado County contributions-----	6,716 77
426	Expenditures Tuolumne County contributions-----	878 23
427	Expenditures Orange County contributions-----	9,001 50
428	Expenditures Nevada County contributions-----	13,953 17
429	Expenditures Stanislaus County contributions-----	14,103 47
430	Expenditures Sierra County contributions-----	17,749 68
431	Expenditures City of Oceanside contributions-----	8,005 49
432	Expenditures Yuba County contributions-----	13,319 30
433	Expenditures Monterey County contributions-----	63,364 58
434	Expenditures Placer County contributions-----	711 91
435	Expenditures Butte County contributions-----	21,350 00
436	Expenditures Lassen County contributions-----	2,853 42
437	Expenditures Sutter County contributions-----	463 59
438	Expenditures Trinity County contributions-----	1,000 00
Total contributions expenditures-----		\$943,785 05

480	Expenditures Federal Aid-----	\$3,586,827 31
76	Discount on Third State Highway Fund Bonds-----	222,160 50

## Cash on hand:

48 Office Fund (headquarters)-----	\$425 00
48A Office Fund (divisions)-----	54,500 00
50 National Bank of D. O. Mills and Company-----	33,752 93
52 Farmers and Mechanics Bank-----	*7,754 76
53 California National Bank-----	8,287 44
53A Sacramento-San Joaquin Bank-----	98 73
54 Capital National Bank (General Fund)-----	20,601 85

Total ----- \$109,911 19

## Funds in treasury:

91 First State Highway Fund-----	\$100,000 00
92 Second State Highway Fund-----	96,169 97
93 Third State Highway Fund-----	6,869,857 33
94 Motor Vehicle Fund-----	286,686 59
95 Chapter 746, Acts 1917 Fund-----	167,559 21
96 Federal Aid Fund-----	
97 Chapter 888, Acts 1921 Fund-----	44,455 89
97B Chapter 883, Acts 1921 Fund-----	30,000 00
97A Chapter 882, Acts 1921 Fund-----	5,429 06
97C Vallejo-Sears Point Survey-----	1,000 00

Total ----- \$7,601,158 05

\*Overdraft.

## EXPENDITURES IN COUNTIES FROM FIRST STATE HIGHWAY FUND.

County	Division	To June 30, 1922*	County	Division	To June 30, 1922*
Alameda -----	IV	\$452,657 79	Orange -----	VII	\$528,908 27
Alpine -----	III		Placer -----	III	364,093 39
Amador -----	III	406 49	Plumas -----	III	58 58
Butte -----	III	306,654 17	Riverside -----	VII	92,442 11
Calaveras -----	III	5,793 78	Sacramento -----	III	103,912 03
Colusa -----	III	493,128 12	San Benito -----	V	230,836 93
Contra Costa --	IV	251,686 37	San Bernardino --	VII	261,021 75
Del Norte -----	I	10,976 95	San Diego -----	VII	622,188 21
El Dorado -----	III	287,149 73	San Francisco --	IV	
Fresno -----	VI	248,399 38	San Joaquin -----	III	4,278 08
Glenn -----	III	250,413 29	San Luis Obispo --	V	823,571 26
Humboldt -----	I	673,221 05	San Mateo -----	IV	425,128 89
Imperial -----	VII	404,895 41	Santa Barbara --	V	839,664 59
Inyo -----	VI	21,609 25	Santa Clara -----	IV	926,022 63
Kern -----	VI	882,644 61	Santa Cruz -----	IV	215,027 48
Kings -----	VI	106,554 38	Shasta -----	II	481,030 22
Lake -----	I	16 04	Sierra -----	III	17,763 75
Lassen -----	II	714 35	Siskiyou -----	II	386,473 19
Los Angeles ----	VII	1,284,762 35	Solano -----	III	402,995 94
Madera -----	VI	220,476 65	Sonoma -----	IV	494,848 22
Marin -----	IV	236,080 41	Stanislaus -----	III	305,356 18
Mariposa -----	VI	190,337 16	Sutter -----	III	107,620 68
Mendocino -----	I	789,719 41	Tehama -----	II	297,610 12
Merced -----	VI	342,940 97	Trinity -----	II	7,029 96
Modoc -----	II	33 06	Tulare -----	VI	245,345 67
Mono -----	VI	88,025 19	Tuolumne -----	III	129,775 75
Monterey -----	V	618,929 66	Ventura -----	VII	607,294 54
Napa -----	IV	19,330 09	Yolo -----	III	762,134 78
Nevada -----	III	8,063 46	Yuba -----	III	121,951 33

Total ----- \$18,000,000 00

General expense, undistributed (premiums on bonds)----- 2,129 00

Grand total ----- \$18,002,129 00

\*As the fund was exhausted on June 30, 1918, there have been no expenditures from this fund since that date.

## EXPENDITURES IN COUNTIES FROM SECOND STATE HIGHWAY FUND.

County	Division	Total to June 30, 1920	July 1, 1920, to June 30, 1921	July 1, 1921, to June 30, 1922	Total to June 30, 1922
Alameda	IV	\$333,983 11	\$176 43	\$3,858 08	\$338,017 62
Alpine	III				
Amador	III	7,668 33	221 92	12,186 94	20,177 19
Butte	III	589,027 98	4,427 22	11,448 05	604,903 25
Calaveras	III	125,336 88	37 62	93 50	125,468 00
Colusa	III	8,659 58	2,926 37	2,699 04	14,284 99
Contra Costa	IV	240,119 23	168 03	1,145 20	241,432 46
Del Norte	I	40,908 22	39,274 09	54,130 42	134,312 73
El Dorado	III	262,443 95	141 51	99 48*	262,485 98
Fresno	VI	117,295 80	4 13	39,163 12	156,468 05
Glenn	III	5,773 14	608 29	5,941 89	12,323 32
Humboldt	I	574,223 04	17,596 30*	73,072 67	629,699 41
Imperial	VII	204,870 98	84,322 68	77,247 46	366,441 12
Inyo	VI	145,182 73	301 84*	29,358 76	174,239 65
Kern	VI	81,841 84	42,175 60	51,501 91	175,519 35
Kings	VI	2,392 24	29,779 49	30,047 23	62,218 96
Lake	I	27,940 18	12,413 13*	3,626 33	19,153 58
Lassen	II	50,984 81	8,621 64	11,895 89	71,502 34
Los Angeles	VII	1,107,450 49	18,197 28	48,477 32	1,174,125 09
Madera	VI	1,187 79			1,187 79
Marin	IV	449,012 45	291 03	1,730 53	451,034 01
Mariposa	VI	193,075 54	391 60	13,214 69	206,681 83
Mendocino	I	908,370 98	1,602 02	18,709 15	928,682 15
Merced	VI	63,732 62	4,967 03*	60,119 22	118,884 81
Modoc	II	44,077 23	13,528 41*	12,954 12	43,502 77
Mono	VI	151,053 99	366 42*	9,895 16	160,582 73
Monterey	V	874,073 62	21,972 50*	1,237 78*	850,863 34
Napa	IV	182,451 12	8 88	2 33	182,462 33
Nevada	III	289,198 31	7,115 03	31,064 90	327,378 24
Orange	VII	62,607 57	26,867 08*	394 22*	35,348 27
Placer	III	53,815 12	2,953 07	21,868 26	78,636 45
Plumas	III	2,573 70	1,194 23	965 01*	2,802 92
Riverside	VII	89,144 14	53,674 57	17,721 22	160,539 93
Sacramento	III	8,910 21	300 15	10,551 19	19,761 55
San Benito	V	1,320 53	104 52	95 84*	1,329 21
San Bernardino	VII	17,565 04	283 90	4,924 55	22,773 49
San Diego	VII	535,940 93	43,582 66	28,044 50	607,568 09
San Francisco	IV		96 58	90 58*	6 00
San Joaquin	III	120,163 78	1,608 53	2,943 20	124,715 51
San Luis Obispo	V	343,279 25	1,884 74	4,629 08	349,793 07
San Mateo	IV	14,363 69	9,690 05	4,032 77*	20,020 37
Santa Barbara	V	718,240 65	69,189 89*	26,599 48	675,650 24
Santa Clara	IV	85,033 72	7,976 95	51,353 40	144,364 07
Santa Cruz	IV	145,841 47	8,601 27	16,770 87	171,213 61
Shasta	II	893,758 57	46,352 17*	77,657 33	925,063 73
Sierra	III	143,688 15	12,670 27	7,588 16	163,946 58
Siskiyou	II	155,379 87	9,098 02*	14,559 07	160,840 92
Solano	III	160,701 00	463 73	20,251 57	181,416 30
Sonoma	IV	264,557 06	1,283 77	66,280 77	332,121 60
Stanislaus	III	61,208 12	14,093 75*	1,240 18	48,354 55
Sutter	III	21 46	611 80	579 95*	53 31
Tehama	II	69,349 32	8,439 22	87,030 21	164,818 75
Trinity	II	128,143 24	50,048 64*	28,874 14	106,968 74
Tulare	VI	471,362 55	330 93*	27,417 51	498,449 13
Tuolumne	III	19,096 53	182 66	19,514 58	38,793 77
Ventura	VII	57,459 39	864 08	39 36	58,362 83
Yolo	III	298,837 12	21,302 78	22,775 81*	297,364 09
Yuba	III	103,870 69	2,779 82	5,767 60	112,418 11
Totals		\$12,108,569 05	\$133,914 10	\$1,114,943 70	\$13,357,426 85

\*Credit, covering federal aid received and cement sacks returned.



## EXPENDITURES IN COUNTIES FROM THIRD STATE HIGHWAY FUND.

County	Division	July 1, 1919, to June 30, 1920	July 1, 1920, to June 30, 1921	July 1, 1921, to June 30, 1922	Total to June 30, 1922
Alameda	IV	\$325 63	\$4,821 03	\$13,450 93	\$18,597 59
Alpine	III				
Amador	III	3,721 72	5,129 01	67,961 48	76,812 21
Butte	III	135,122 18	103,877 38	201,808 89	440,808 45
Calaveras	III	5,400 97	1,115 62	5,208 19	11,724 78
Colusa	III	14,328 72	35,031 01	20,788 32	70,148 05
Contra Costa	IV	4,967 83	1,956 12	21,371 31	28,295 26
Del Norte	I	102,656 42	134,764 70	191,564 58	428,985 70
El Dorado	III	3,984 04	1,160 07	25,124 86	30,268 97
Fresno	VI	62,234 77	40,293 59	484,781 25	587,309 61
Glenn	III	9,268 99	9,220 25	30,058 98	48,548 22
Humboldt	I	126,576 77	303,580 12	759,991 44	1,190,148 33
Imperial	VII	296,009 75	279,492 46	389,499 95	965,002 16
Inyo	VI	34,559 43	31,157 61	205,991 00	271,708 04
Kern	VI	87,903 05	243,627 19	428,114 18	759,644 42
Kings	VI	57 58	131,252 67	230,294 84	361,605 09
Lake	I	73,743 93	20,887 53	40,013 72	134,645 18
Lassen	II	9,405 59	63,207 93	216,512 24	289,125 76
Los Angeles	VII	136,442 14	180,538 80	516,790 42	833,771 36
Madera	VI	198 42	18 12	8,880 37	9,096 91
Marin	IV	3,871 89	5,349 12	84,862 95	94,083 96
Mariposa	VI	34,131 85	9,784 39*	93,717 67	118,065 13
Mendocino	I	151,716 34	36,998 03	303,838 87	492,553 24
Merced	VI	43,648 17	118,258 40	600,325 42	762,231 99
Modoc	II	22,455 74	80,081 48	177,918 55	280,455 77
Mono	VI	26,005 07	53,643 06	120,648 96	205,297 39
Monterey	V	126,838 89	51,731 07*	89,655 25	164,763 07
Napa	IV	7,023 24	49 25	11,189 78	18,262 27
Nevada	III	74,357 15	115,414 35	165,529 02	355,300 52
Orange	VII	31,877 36	3,576 44	9,321 08	44,774 88
Placer	III	15,957 06	7,077 74	78,875 37	101,910 17
Plumas	III	1,102 79	9,801 28	34,620 19	45,524 26
Riverside	VII	87,999 55	196,442 23	12,833 46*	271,608 32
Sacramento	III	111 33	12,641 63	24,662 32	37,415 28
San Benito	V	553 15	1,421 80	3,723 83	5,698 78
San Bernardino	VII	23,462 30	1,801 27*	212,258 07	233,919 10
San Diego	VII	207,725 55	416,940 48	81,763 99*	542,902 04
San Francisco	IV	218 99	2,512 94	33,613 48	36,345 41
San Joaquin	III	115,453 18	14,951 06	35,682 01	166,086 25
San Luis Obispo	V	14,047 53	45,534 95	539,857 00	599,439 48
San Mateo	IV	12,479 01	64,514 66	90,613 43	167,607 10
Santa Barbara	V	53,953 86	96,051 89	417,632 91	567,638 56
Santa Clara	IV	57,316 18	131,551 00	227,041 04	415,908 22
Santa Cruz	IV	9,336 33	131,522 84	42,735 99	183,595 16
Shasta	II	47,518 95	67,415 25	549,831 13	664,765 33
Sierra	III	11,031 52	85,438 78	39,786 68	136,256 98
Siskiyou	II	51,984 31	35,627 54	157,654 29	245,266 14
Solano	III	4,602 92	7,627 99	187,595 63	199,826 54
Sonoma	IV	31,695 84	9,819 62	398,381 01	439,896 47
Stanislaus	III	103,690 32	149,200 80	37,580 15*	215,310 27
Sutter	III	4,413 12	19,373 18	137,771 29	161,557 59
Tehama	II	96,400 35	361,260 80	746,182 89	1,203,844 04
Trinity	II	72,008 00	82,927 21	218,746 82	373,682 03
Tulare	VI	9,727 32	2,164 98	5,074 47	16,966 77
Tuolumne	III	21,127 33	4,268 74	126,076 50	151,472 57
Ventura	VII	48,762 37	61,236 48	32,887 91	142,886 76
Yolo	III	18,229 64	137,876 07	49,236 44	205,342 15
Yuba	III	2,862 28	11,895 27	21,125 24	35,882 79
Totals		\$2,752,604 71	\$4,113,281 82	\$9,794,702 84	\$16,660,589 37

\*Credit, covering federal aid received and cement sacks returned.

**STATEMENT OF EXPENDITURES FROM ALL FUNDS COMING UNDER  
CONTROL OF THE CALIFORNIA HIGHWAY COMMISSION,  
1912 - 1917, INCLUSIVE.**

Month	Fund	1912	1913	1914	1915	1916	1917
January	Bond Issues		\$ 127,761.95	\$ 100,352.70	\$ 470,566.72	\$ 477,770.64	\$ 146,344.05
	Contributions						
	Federal Aid						
	Motor Vehicle Fees				14,859.35	107,152.46	53,155.60
	Special Appropriations						1,963.27
	Total		\$ 127,761.95	\$ 100,352.70	\$ 485,426.07	\$ 584,923.10	\$ 201,462.93
February	Bond Issues		147,409.73	204,336.82	704,103.90	344,996.50	-25,308.56
	Contributions						
	Federal Aid						
	Motor Vehicle Fees				14,320.98	117,911.14	68,422.48
	Special Appropriations						1,605.44
	Total		\$ 147,409.73	\$ 204,336.82	\$ 718,424.78	\$ 462,907.64	\$ 44,719.36
March	Bond Issues	\$ 66,169.77	132,558.63	152,264.68	446,381.31	196,291.20	71,932.49
	Contributions						
	Federal Aid						
	Motor Vehicle Fees				11,348.85	111,198.18	69,749.70
	Special Appropriations						1,389.62
	Total	\$ 66,169.77	\$ 132,558.63	\$ 152,264.68	\$ 457,730.16	\$ 307,489.38	\$ 142,531.81
April	Bond Issues	29,041.26	128,735.95	124,000.34	402,961.70	249,971.52	68,955.11
	Contributions						
	Federal Aid						
	Motor Vehicle Fees				10,619.35	150,851.23	37,119.28
	Special Appropriations						35.51
	Total	\$ 29,041.26	\$ 128,735.95	\$ 124,000.34	\$ 413,581.05	\$ 400,822.75	\$ 106,109.90
May	Bond Issues	36,984.09	161,686.48	319,883.26	842,483.57	244,740.93	135,735.56
	Contributions						
	Federal Aid						
	Motor Vehicle Fees						
	Special Appropriations				46,494.94	198,516.33	57,360.18
	Total	\$ 36,984.09	\$ 161,686.48	\$ 319,883.26	\$ 888,978.51	\$ 363,257.26	\$ 194,094.52
June	Bond Issues		191,472.79	261,915.68	518,340.96	190,504.11	89,475.39
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			4,655.17	18,007.48	98,894.69	86,535.75
	Special Appropriations						-250.80
	Total		\$ 191,472.79	\$ 266,570.85	\$ 536,348.44	\$ 279,398.80	\$ 177,760.34
July	Bond Issues	71,756.93	142,060.46	179,706.79	856,658.32	279,490.53	138,796.41
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			6,289.40	39,250.80	119,258.88	58,235.54
	Special Appropriations						-147.98
	Total	\$ 71,756.93	\$ 142,060.46	\$ 185,995.79	\$ 895,909.12	\$ 398,749.41	\$ 196,943.97
August	Bond Issues	48,468.33	187,313.82	604,768.55	911,250.51	211,883.29	243,823.74
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			7,753.05	43,924.10	82,210.47	79,701.05
	Special Appropriations					250.00	
	Total	\$ 48,468.33	\$ 187,313.82	\$ 612,521.60	\$ 955,174.61	\$ 294,343.76	\$ 323,524.79
September	Bond Issues	61,525.73	184,654.23	614,315.94	546,794.95	224,942.94	34,333.37
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			13,685.65	33,934.65	62,062.44	50,028.15
	Special Appropriations					996.01	-2.33
	Total	\$ 61,525.73	\$ 184,654.23	\$ 628,001.59	\$ 580,729.60	\$ 288,001.39	\$ 84,259.19
October	Bond Issues	66,411.79	279,564.39	454,404.06	791,684.52	168,721.69	322,110.31
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			10,266.48	41,563.59	58,330.39	79,589.18
	Special Appropriations					2,044.25	-1,362.67
	Total	\$ 66,411.79	\$ 279,564.39	\$ 464,670.54	\$ 833,238.11	\$ 229,156.33	\$ 400,336.82
November	Bond Issues	56,950.64	212,541.43	1,044,551.06	774,664.76	148,331.91	433,443.84
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			29,550.87	82,204.20	48,103.39	53,114.42
	Special Appropriations					2,231.88	
	Total	\$ 56,950.64	\$ 212,541.43	\$ 1,074,101.93	\$ 856,868.96	\$ 198,657.18	\$ 486,558.26
December	Bond Issues	134,802.04	202,965.75	494,725.25	580,363.63	346,767.55	334,485.44
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			11,735.23	98,376.21	105,362.50	76,911.82
	Special Appropriations					6,217.38	
	Total	\$ 134,802.04	\$ 202,965.75	\$ 506,460.48	\$ 678,740.04	\$ 458,347.43	\$ 411,297.26
Totals by Year	Bond Issues	594,110.58	2,098,745.61	4,555,224.73	7,846,255.05	3,084,412.81	1,993,487.16
	Contributions						
	Federal Aid						
	Motor Vehicle Fees			83,936.85	454,694.40	1,189,612.10	772,463.15
	Special Appropriations					11,739.52	3,568.84
	GRAND TOTAL	\$594,110.58	\$2,098,745.61	\$4,639,160.58	\$8,301,149.45	\$4,285,964.43	\$2,769,539.15

**STATEMENT OF EXPENDITURES FROM ALL FUNDS COMING UNDER  
CONTROL OF THE CALIFORNIA HIGHWAY COMMISSION,  
1918 TO JUNE 30, 1922.**

Month	Fund	1918	1919	1920	1921	1922	
January	Bond Issues	\$ 330,189.34	\$ 349,025.42	\$ 785,708.90	\$ -161,725.36	\$ 489,150.40	
	Contributions					453.59	
	Federal Aid				342,024.05	339,050.00	
	Motor Vehicle Fees	72,962.73	105,112.65	106,899.24	385,939.92	296,194.25	
	Special Appropriations		3,343.35	2,454.09		165.17	
	Total	\$ 403,152.07	\$ 456,481.42	\$ 895,062.23	\$ 566,238.59	\$ 1,125,033.41	
February	Bond Issues	367,050.22	182,273.03	557,718.38	317,084.59	345,164.43	
	Contributions		1,568.66	506.87		1,000.00	
	Federal Aid				73,256.32	355,941.89	
	Motor Vehicle Fees	65,946.52	96,198.73	74,265.99	162,465.11	196,812.80	
	Special Appropriations		425.00	35.76		139.50	
	Total	\$ 433,006.74	\$ 280,556.22	\$ 632,526.70	\$ 553,636.02	\$ 899,456.62	
March	Bond Issues	276,916.47	222,395.54	677,325.52	346,374.54	833,045.64	
	Contributions		14,000.00			2,190.38	
	Federal Aid			222,160.50	129,097.37	53,711.40	
	Motor Vehicle Fees	61,924.14	99,162.69	82,432.33	198,344.38	391,367.83	
	Special Appropriations		-190.11	136.70		5.40	
	Total	\$ 340,840.61	\$ 345,368.12	\$ 982,095.05	\$ 673,816.29	\$ 1,283,161.27	
April	Bond Issues	396,352.72	285,354.31	661,538.97	500,526.91	788,496.38	
	Contributions		2,547.96		11,000.00	5,041.00	
	Federal Aid					205,797.82	
	Motor Vehicle Fees	72,233.47	117,346.25	177,709.10	158,269.07	274,535.00	
	Special Appropriations	342.58	-36.55	-34.83		53.00	
	Total	\$ 468,928.77	\$ 405,209.98	\$ 839,213.24	\$ 669,794.98	\$ 1,272,072.58	
May	Bond Issues	509,997.12	458,738.23	695,250.68	659,752.55	1,203,740.88	
	Contributions		45,729.20	11,146.39	1,971.32	5,500.00	
	Federal Aid			68,746.58		43,943.56	
	Motor Vehicle Fees	71,545.29	167,958.92	127,073.44	219,977.61	238,431.91	
	Special Appropriations	1,935.72	861.85			1,225.45	
	Total	\$ 583,479.13	\$ 673,368.25	\$ 833,480.51	\$ 950,448.05	\$ 1,493,341.80	
June	Bond Issues	561,773.62	453,622.13	601,020.75	834,616.59	1,314,513.92	
	Contributions	531,761.96	5,702.57		50,000.00	5,237.24	
	Federal Aid	59,571.76			10,588.00	362,222.87	
	Motor Vehicle Fees	61,840.13	168,432.76	191,352.30	233,435.84	373,592.97	
	Special Appropriations	1,136.08	1,268.88			-1,692.64	
	Total	\$ 1,236,189.57	\$ 629,016.34	\$ 792,373.05	\$ 1,128,540.43	\$ 2,054,574.36	
July	Bond Issues	567,612.47	390,118.13	599,978.37	394,326.29		
	Contributions	5,992.00		32,386.24	21,350.00		
	Federal Aid				405,132.67		
	Motor Vehicle Fees	89,115.60	159,527.11	130,531.55	162,014.41		
	Special Appropriations	2,132.31	905.65	20.00			
	Total	\$ 664,852.58	\$ 550,550.89	\$ 752,916.16	\$ 982,823.57		
August	Bond Issues	469,432.59	564,050.15	75,688.13	915,879.59		
	Contributions		256.03	134,009.69			
	Federal Aid			388,901.03	291,235.15		
	Motor Vehicle Fees	127,194.63	155,907.88	159,251.99	342,036.12		
	Special Appropriations	8,752.05	1,428.97				
	Total	\$ 605,379.27	\$ 721,683.03	\$ 717,861.04	\$ 1,549,150.86		
September	Bond Issues	423,566.45	469,194.60	400,334.96	1,443,107.82		
	Contributions		5,300.00				
	Federal Aid			24,996.10			
	Motor Vehicle Fees	82,409.67	132,164.35	139,831.40	300,707.71		
	Special Appropriations	5,355.25	721.32				
	Total	\$ 511,331.37	\$ 607,380.27	\$ 565,162.46	\$ 1,743,815.53		
October	Bond Issues	499,190.39	750,095.65	523,501.66	1,229,709.13		
	Contributions			27,354.56			
	Federal Aid			72,777.13	67,003.66		
	Motor Vehicle Fees	104,323.07	156,876.77	223,606.05	347,982.85		
	Special Appropriations	3,030.06	3,437.57				
	Total	\$ 606,543.52	\$ 910,409.99	\$ 847,249.42	\$ 1,644,695.64		
November	Bond Issues	380,215.57	624,058.96	466,379.00	1,332,175.31		
	Contributions		4,765.49	711.91	518.92		
	Federal Aid			21,380.99	14,326.96		
	Motor Vehicle Fees	56,293.35	84,575.43	175,921.40	340,562.13		
	Special Appropriations	344.11	43,846.41		1,777.60		
	Total	\$ 436,853.03	\$ 756,947.29	\$ 664,593.30	\$ 1,690,383.82		
December	Bond Issues	539,150.69	726,536.72	390,486.05	1,395,224.41		
	Contributions	2,707.88		140.92	10,292.72		
	Federal Aid				116,398.93		
	Motor Vehicle Fees	137,238.02	73,261.65	229,800.80	444,765.74		
	Special Appropriations	721.29	319.12		23,666.24		
	Total	\$ 679,817.88	\$ 800,117.49	\$ 757,090.75	\$ 1,991,299.04		
Totals by Year	Bond Issues	5,363,463.65	5,484,523.72	6,384,941.68	9,208,851.35	4,975,111.65	351,589,127.89
	Contributions	540,487.85	73,999.31	229,286.30	95,132.96	22,532.21	944,399.24
	Federal Aid	59,571.76		871,078.72	1,516,359.99	1,359,977.54	1,605,967.51
	Motor Vehicle Fees	1,051,125.82	1,516,526.20	1,814,725.59	3,226,933.69	1,770,424.76	11,962,862.76
	Special Appropriations	23,744.45	56,039.46	2,511.72	22,463.84	-304.12	122,863.71
	GRAND TOTAL	\$6,990,374.54	\$7,137,089.23	\$9,279,623.91	\$14,144,741.83	\$8,127,742.04	\$68,368,241.41



## APPENDIX F.

## PURCHASING DEPARTMENT.

By LOWELL R. SMITH, Purchasing Agent.

The work of this department has materially increased during the past two years so that now, in addition to the purchasing agent, there are two assistant purchasing agents.

Since August 1, 1921, this department has carried on the purchasing for the State Department of Public Works, consisting of the following divisions:

Division of Highways.

Division of Architecture.

Division of Engineering and Irrigation.

Division of Water Rights.

Division of Land Settlement.

On the above date on account of such additional duties it was necessary to add the second assistant purchasing agent to the force.

The following tabulation of purchase orders issuing from this department will show the increase of work from year to year:

Year	Number of orders issued
1912	487
1913	858
1914	2,180
1915	2,338
1916	3,193
1917	5,510
1918	6,774
1919	10,216
1920	11,585
1921	17,263
1922 to June 30	10,770

Prior to August 1, 1921, all orders as shown above were issued for the California Highway Commission. The following is a segregation of number of orders issued in 1921 and during the present year to and including June 30, 1922:

*Year 1921.*

Division of Highways	16,180
Division of Architecture	750
Division of Engineering and Irrigation	151
Division of Land Settlement	133
Division of Water Rights	49

*Year 1922 to June 30.*

Division of Highways	9,353
Division of Architecture	1,058
Division of Engineering and Irrigation	150
Division of Land Settlement	81
Division of Water Rights	128

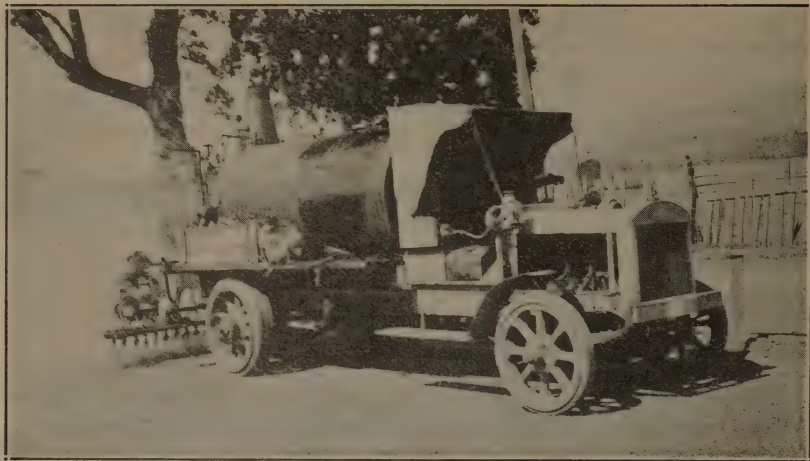


Plate LXIII. State Highway, Mendocino County, oiling resurfaced macadam pavement.



Plate LXIV. State Highway, Mendocino County, completed resurfaced asphalt macadam.

The number of orders issuing from this department for the present year will probably be in the neighborhood of 25,000. The total number of employees in the purchasing department, including clerks and stenographers, is nine.

During the biennium ending June 30, 1920, as was mentioned in that report of the purchasing department, work was seriously hampered on account of scarcity of many commodities entering into building construction. This situation has greatly improved during the past two years with the exception that during the present year a serious shortage of cement, especially in the northern part of the state, exists. The cement companies attribute this condition to the enormously increased building operations, claiming the demand for cement far exceeds the production.

Freight rates on all commodities remained unchanged up to the close of this biennium. However, on July 1, 1922, a general reduction of 10 per cent on all commodities was made. Full tariff rates are being paid on all commodities, no special rates being extended to the state as was done prior to August 5, 1918.

While the records of this department show that prices on various commodities generally have declined, they are still considerably above pre-war prices, especially on major items of construction material. Prices on rock, sand and gravel have not made any appreciable decrease since the peak prices of 1920. Reinforcing steel has shown a considerable drop, going as low as \$2.35 per cwt. base during the spring of the present year as against a peak price of \$5 per cwt. base during the close of the year 1920 and the early spring of 1921. The mill base price of cement during the close of 1920 was generally \$2.70 net per barrel at the mill. The price on this commodity made several slight decreases from time to time since then, the present price being \$2.35 net per barrel.

Appended to this report is a detailed statement of cement purchases made from 1920 to June 30, 1922.

Below is given a recapitulation of all cement deliveries to the California Highway Commission from year 1912 to June 30, 1922, showing that the average mill base price paid for the cement during that period was \$1.673.

Year	(barrels) Total deliveries	at mill Total cost	Average per barrel mill base
1912	142,465.50	\$176,683 24	\$1.240
1913	242,514.50	317,376 36	1.309
1914	677,790.25	898,403 48	1.325
1915	355,005.50	485,267 31	1.367
1916	110,090.00	150,958 28	1.371
1917	220,794.00	321,064 61	1.454
1918	221,418.00	359,036 76	1.621
1919	241,581.00	464,342 77	1.922
1920	312,304.00	677,290 29	2.168
1921	540,127.00	1,231,801 11	2.280
1922	70,290.00	163,611 64	2.327
	3,134,379.75	\$5,245,835 85	\$1.673

The small deliveries of cement shown for period to June 30, 1922, are accounted for by the fact that these deliveries include only cement delivered on contracts let during that period. Some of the contracts awarded



in 1921 extended into 1922 and deliveries of cement on such contracts during 1922 are shown in the 1921 deliveries. Furthermore, some of the larger contracts for cement concrete roads were let shortly before June 30, 1922, and large cement deliveries did not start until after that date. The total cement purchased during the year 1922 up to June 30 was 194,288 barrels.

In conclusion, it may again be said that the records of few departments will show such a diversity of commodities purchased. On contract work, this department purchases all road material, such as cement, rock, sand, gravel, culvert pipe and reinforcing steel. In connection with day labor work, and particularly that in the convict labor camps, a wide diversity of wants are met, embracing in the case of free labor camps, not only the materials of construction, but food supplies, tools, road machinery, hay and grain, camping outfits, gasoline, oils and greases, and all other supplies necessary for carrying on such work. In the case of convict labor camps, in addition to the above, clothing, medicines, barber supplies and tobacco are but a few of the many purchases made for the Division of Highways. Also extensive purchases of electrical materials, building hardware, plumbing supplies and equipment, building tile and brick, paints and all other materials and supplies entering into the construction of buildings are purchased for the Division of Architecture. Various other items are purchased for state institutions, such as moving picture machines, milking machines, etc. Purchases for the Division of Land Settlement include such items as concrete pipe machinery, alfalfa seed, barley seed, etc.

The above will give a general idea of the great range of commodities purchased, although they are but a few of the hundreds of items being bought.

## APPENDIX G.

## HIGHWAY TREE PLANTING.

By M. B. PRATT, State Forester, and  
W. S. CARUTHERS, Assistant Highway Engineer.

Systematic planting of trees on the state highways of California was made possible through the establishment of a state nursery, in 1920, where thousands of trees are now being propagated annually for this purpose. This nursery, which is a result of the cooperative efforts of the California State Highway Commission and the State Board of Forestry, is located along the state highway between Davis and Sacramento. It is in charge of Albert Aldinger, a trained nurseryman, and consists of an attractive group of buildings of colonial design, consisting of the nurseryman's cottage, bunk house for his helpers, barn and implement shed. Back of this group is a lath house, pumping house, and reservoir. Last year 7600 trees were propagated and distributed for planting on the state highways, and this year 60,000 trees will be available for this purpose. The principal trees that have been grown so far are California black walnut, European sycamore, Lombardy poplar, American elm, and black locust.

The plan of highway planting that is being used is a cooperative one, which involves three different agencies: the California Highway Commission, the State Board of Forestry, and the agency which makes application to plant the trees. As soon as an application is received by the Highway Commission to plant trees along the state highway, it is referred to the Highway Tree Planting Committee, consisting of the State Highway Engineer, State Forester, State Gardener and the Professor of Landscape Architecture of the University of California, which prepares a plan with detailed instructions for the planting, after examination of the locality for which application is made. This plan is used as a basis for the terms of the planting permit, issued by the Highway Commission.

After the permit is issued, the stakes marking the location of the trees are set by a survey party for the Highway Commission. In setting these stakes it is the aim to have the trees placed in the clear as much as possible, so that their symmetrical growth will not be interfered with in years to come, by overhead wires. No stakes are set within 100 feet of road intersections and 200 feet of railroad crossings, or within 75 feet of the beginning of the inside of curves, where trees might obscure the vision of the traveling public. The trees are spaced 100 feet apart and planted in alternate arrangement on the two sides of the highway. This gives a fifty-foot effect, and does not restrict the view of the adjoining landscape.

The entire cost of planting is borne by the applicant. As a general rule it is required that holes three feet in diameter and three feet deep be dug, and that each tree be supported by a stout stake and protected against stock by a cylinder of woven wire netting. The trees are furnished from the state nursery, the only cost to the applicant being that



Plate LXV. State Nursery Buildings, Davis.

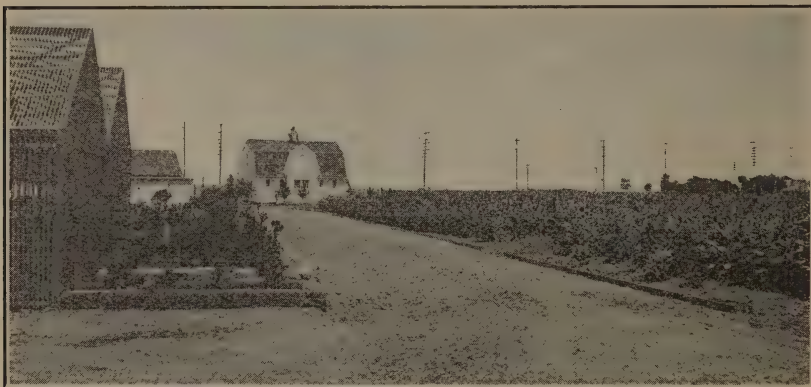
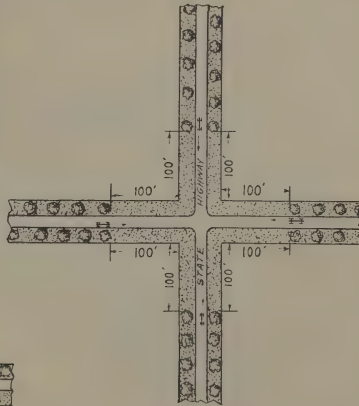
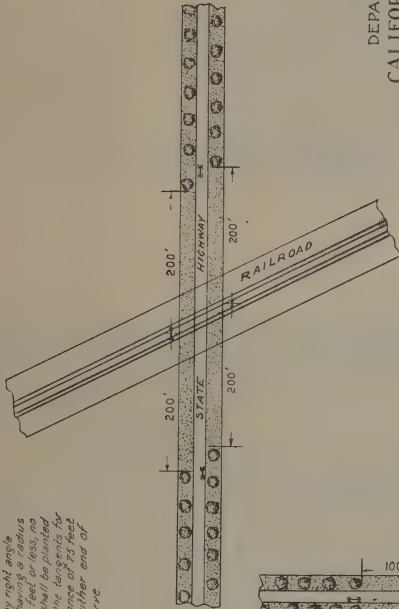
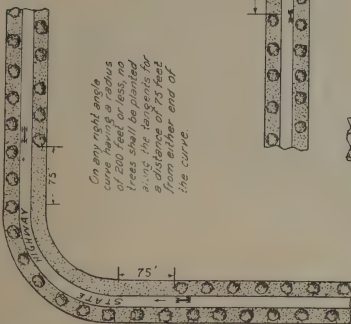
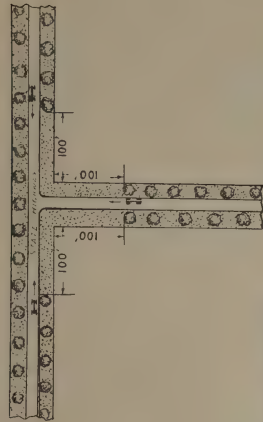


Plate LXVI. State Nursery, showing buildings and stock.



Plate LXVII. State Nursery, trees ready for transplanting along State Highway.





STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS  
CALIFORNIA HIGHWAY COMMISSION

PLANS SHOWING DETAILS FOR TREE PLANTING ALONG  
CURVES, ROAD INTERSECTIONS AND RAILWAY CROSSINGS  
OF THE STATE HIGHWAYS.

SCALE 1 in. = 60 feet.

All trees must be planted according to the specifications, and under the direct supervision of the State Board of Forestry.

On any curve of 200 feet or more radius, trees shall be planted on the concave side only in such a manner as to provide a clear vision of not less than 200 feet.

No trees shall be planted on a reverse curve either on concave or convex sides, where the view will be obscured, except where indicated by the State Board of Forestry.

All lines, position and spacing in tree planting shall be set by the California Highway Commission.

of transportation from the nursery. The cost of planting on the average, unless it is necessary to blast holes in hard pan or rock when the cost is augmented by about 25 per cent, does not exceed \$1 per tree. In many cases it can be done for less, especially where soil conditions are favorable. In some cases planting has been done by community effort, as at Orland, where three hundred and fifty volunteers planted seven miles of trees in one day. This means of planting is laudable, inasmuch as it develops community spirit, but it is necessary that the work be well organized and carried out, since the chances of survival of the trees is directly dependent upon the care with which they are planted.

After the trees are planted, they are maintained by the Highway Commission, which is a task of no mean proportions. The trees must be watered and cultivated with regularity, the grass must be burned to guard against roadside fires, drainage facilities must be provided, and there must be a constant warfare against pests, such as gophers, grasshoppers and borers. Experience during the past two years has shown that one of the greatest sources of loss has been from drowning, due to the standing water resulting from irrigation operations in adjoining fields. It is always to be expected that some losses will occur due to the many hazards to which young trees are subjected, and it will only be by constant effort and replacement of the trees, that are lost from year to year, that a uniform planting can be secured.

It was soon realized that the services of a tree expert were necessary to give advice concerning the care of the trees along the state highway, and this spring Mr. W. E. Glendinning was employed in this capacity. He has given attention to all trees planted on the state highway under the plan now in effect, and his recommendations have been carried out by those in direct charge of the maintenance of the trees. As a result, many trees have been saved through receiving special care at the critical time. Reports on 5600 trees examined by Mr. Glendinning show an 85 per cent survival. The percentage of survival will steadily increase as better methods for the planting and care of the trees are developed.

Prior to the highway tree planting plan now being followed, Kern County planted trees along the state highway for a distance of twenty miles. Those trees were planted on desert land, where the conditions were most unfavorable. The Highway Commission has maintained these trees with much effort since 1915, and as a result a road that would otherwise be most unattractive and uncomfortable during the summer season, has been made an object lesson of what can be accomplished by systematic tree planting. A tree count this summer showed that 80 per cent of the 3400 trees that were planted are in a flourishing condition. Plans are now being made to fill all gaps in this planting, and to extend it for several miles with trees from the state nursery.

Highway tree planting permits have been issued from and including 1920 to the end of the fiscal year 1922 for a total of 99.85 miles, as shown in detail in the following table:

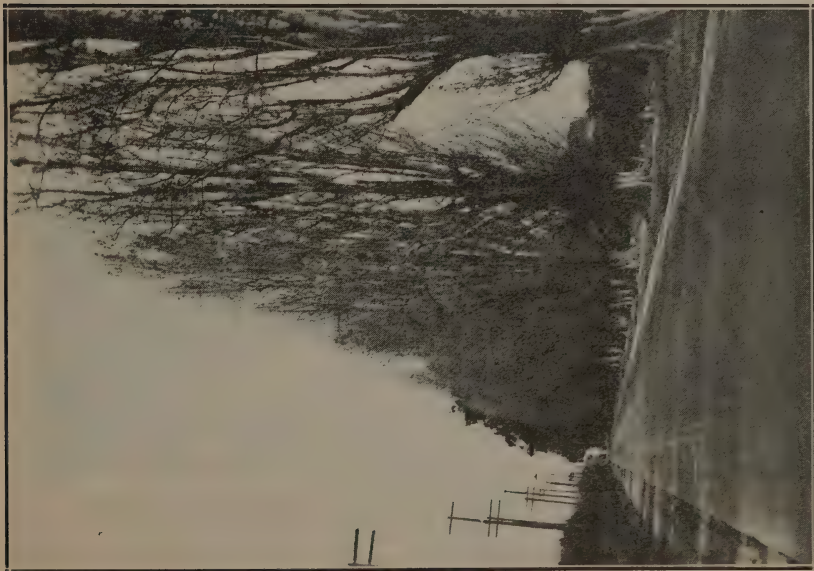


Plate LXVIII. State Highway, Orange County, showing trees along road.



Plate LXIX. State Highway, Orange County, road protected by trees on either side.





Plate LXX. State Highway, Placer County, asphalt macadam pavement, applying hot oil.



Plate LXXI. State Highway, Placer County, rolling asphalt macadam pavement.

## TREE MAINTENANCE ACCOUNT.

Total amount expended to June 30, 1922.

Division	Section	Amount	Distance miles	Cost per mile per year	Years
II	Miscellaneous expense-----	\$52 25	-----	-----	1922
III	Butte-3-A } -----	1,310 09	8.53	\$76 79	1921-1922
	Butte-21-A } -----				
	Sacramento-3-A } -----	5,800 88	18.15	159 79	1921-1922
	Sacramento-3-B } -----				
	Sacramento-11-B } -----				
IV	Sonoma-1-C -----	1,940 71	14.64	59 45	1921-1922
V	Miscellaneous expense --	38 00	-----	-----	1922
VI	Kern-4-B -----	49,145 59†	17.00	269 24	1915-1922 inc.
	Kern-4-C -----	4,473 23	3.00	186 38	1915-1922 inc.
	Madera-4-B -----	365 01	2.00	91 25	1921-1922
VII	Miscellaneous expense --	160 00	-----	-----	1922
Totals-----		\$63,285 76	63.32		

†Includes \$12,530.15, cost of 2" pipe line—amount not included in cost per mile per year.

## TOTAL TREE PLANTING PERMITS ISSUED TO JULY 1, 1922.

Division	Permit	Section	Dist.	To whom issued	Species
I	335	Humboldt-1-A-B -----	0.64	Civic Club Garber- ville	Black locust
	2294	Humboldt -----	1.00	Fortuna Board of Trade	Black locust
III	2828	Butte-3-A -----	2.25	Gridley Chamber of Commerce	European sycamore and black walnut
	2802	Butte-21-A -----	6.25	Oroville Chamber of Commerce	Black walnut and Oriental plane
	359	Butte-3-C -----	1.00	Chico Chamber of Commerce	Pistachio and black walnut
	2170	San Joaquin-4-C-----	0.80	Woman's Club of Lodi	Oriental plane
	2874	Placer-17-A -----	0.45	Woman's Club of Loomis	Black walnut
	2859	Stanislaus-13-A -----	0.07	Paul Burton	Black walnut
	249	Glenn-7-B -----	5.00	Willows Chamber of Commerce	Black walnut
	35	Sacramento-4 approx.	20.00	Sacramento County Board of Forestry	American elm
	309	Yolo-6-A-C -----	19.17	Board of Supervi- sors, Yolo County	Lombardy poplars, live oak and black walnut
	472	Nevada-17-B -----	0.44	Frances Jones	Scarlet maple
	302	Glenn-7-C -----	7.00	Orland Chamber of Commerce	Black Walnut
IV	2801	Sonoma-1-C -----	5.52	Cotati Company	Black walnut
	2834	Sonoma-1-C -----	5.35	Petaluma Civic Organization	English elm, Nor- way maple, Euro- pean sycamore and European linden
	2891	Sonoma-1-C -----	3.77	Santa Rosa Cham- ber of Commerce	European sycamore and European linden
IV	2272	Sonoma-1-B -----	0.50	Healdsburg Cham- ber of Commerce	Canary Island date palm
	2875	Napa-8-A -----	0.90	Napa Chamber of Commerce	Black walnut
	2872	Santa Clara -----	0.06	F. Maggini	English walnut
	458	San Mateo-2-A -----	2.00	Foresters of America	European sycamore
	519	Marin-1-B -----	3.50	Marin County Federation of Women's Clubs	Tanbark oak

Division	Permit	Section	Dist.	To whom issued	Species
	26	Alameda-5-D -----	0.07	H. B. Shoemaker	English walnut
	419	Contra Costa-14-A ---	0.45	Union Oil Company	Black walnut
VI	438	Inyo-23-B -----	1.83	Aberdeen Fish Springs Farm Center	Lombardy poplars
	370	Madera-4-B -----	1.00	Madera Chamber of Commerce	American elm
	2829	Madera-4-B-C -----	2.00	Madera Chamber of Commerce	English elm
	2915	Kern-4-F -----	0.04	Geo. L. King	Black acacia
	320	Tulare-4-A -----	0.23	Pixley Townsite Improvement Committee	English elm
	2831	Tulare-4-C -----	1.00	Tulare Board of Trade and Tulare Woman's Club	Arizona cypress
	386	Tulare-4-D -----	6.51	Visalia Welfare Club	Valley oak
	2830	Tulare-4-B 10-B-----	1.00	Visalia Board of Trade	Deodar
VII	369	Los Angeles-23-E-----	0.05	Jos. Aebischer	Black locust
			<hr/> 99.85		



## APPENDIX H.

## TRAFFIC REGULATION.

By MAJOR C. L. J. FROHWITTER, former Superintendent of Traffic Regulation.

The decision of the Highway Commission to take steps to protect the state highways from abuse and damage by trucks and other vehicles transporting loads in excess of the legal limit permissible under the provisions of the California Motor Vehicle Act was brought about by the condition of the state highways in different parts of the state.

In October, 1921, the Motor Vehicle Department was asked to co-operate in this work through its field deputies. The equipment for the purpose consisting of motor transportation and loadometers, was furnished by the California Highway Commission.

For about three weeks from October 28, 1921, two field deputies with equipment operated over the state highways in parts of Stanislaus, San Joaquin, Alameda, Santa Clara, Santa Cruz and Monterey counties.

The Highway Commission finally decided to undertake the work independent of the Motor Vehicle Department, by putting out five one-man crews with necessary equipment and by obtaining support of the several counties through the county traffic officers.

Visits to county officials of all counties in which traffic regulation was planned were made and agreements reached that a county traffic officer would accompany the Highway Commission employee whenever he was patrolling or operating over the state highway in each particular county.

The five employees were designated traffic regulation inspectors.

The traffic regulation was to be confined to discovering vehicles carrying loads exceeding the legal limit, vehicles with solid rubber tires with less thickness than permitted by law, and tractors moving over the highways without permits or in violation of the conditions thereof.

Assignments were made between December 5, 1921, and January 30, 1922, to the following territories:

1. San Francisco as centre:  
(Dec. 5, 1921)  
Counties of Humboldt, Mendocino, Sonoma, Marin, San Mateo, Santa Clara, Santa Cruz, San Benito, Monterey.
2. Bakersfield as centre:  
(Dec. 9, 1921)  
Counties of Fresno, Tulare, Kings, Kern and Los Angeles from Kern County line to San Fernando.
3. Los Angeles as centre:  
(Dec. 27, 1921)  
Counties of San Luis Obispo, Santa Barbara, Ventura, Orange, San Diego, Imperial, Riverside, San Bernardino and Los Angeles, excepting from San Fernando north to Kern County line.
4. Stockton as centre:  
(Jan. 18, 1922)  
Counties of Contra Costa, Alameda, San Joaquin, Stanislaus, Merced, Madera.

5. Oroville as centre :  
(Jan. 30, 1922)

Counties of Napa, Solano, Yolo,  
Colusa, Glenn, Tehama, Shasta,  
Butte, Sutter, Yuba, Nevada, Placer,  
El Dorado, Sacramento.

At the start, each man was taken over the state highways in the territory assigned and practical instruction given in the method of weighing vehicles with loadometers.

Patrolling of the state highways then commenced. No definite hours were fixed, night patrolling and weighing were often the rule, particularly in Los Angeles and Kern counties, through and out of which the bulk of long haul freight moves during night hours.

The utmost care was taken against doing an injustice when weighing any vehicle. The ground selected was such as to put as near as possible the front and rear wheels in the same horizontal plane, so there would be little, if any, forward or rear thrust of the load. The rear end was raised with the loadometers until the rear axle was level, the loadometers being placed symmetrically with reference to the medial line of the vehicle from front to rear. The front axle was leveled with a screw jack so there would be no torsion of the chassis or running gear of the vehicle. The dial readings of the loadometers were then taken. Similarly the weights on the front wheels were found.

The loadometers were frequently tested against corresponding public scale weights, weighing the rear end of a truck simultaneously with scales and loadometers. When found necessary the loadometers were adjusted by a sealer of weights and measures. Record was made of every loadometer weighing and forwarded to headquarters for file.

STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS  
CALIFORNIA HIGHWAY COMMISSION

# TRAFFIC REGULATION RECORD

COUNTY

OWNER AND ADDRESS		DRIVER AND ADDRESS				KIND OF TRUCK	REGISTRY NUMBER
TIRES : SOLID		METAL		PNEUMATIC		ACTION TAKEN	
WIDTHS, INCHES	ALLOWABLE LOAD	LOADOMETER	TIRE OVERLOAD	INCH OVERLOAD	THIN TIRES MEASUREMENTS	LOAD ADJUSTED	
R.R.						OVERLOAD REMOVED	
L.R.						SUMMONS SERVED NO.	
R.F.						COURT ACTION	
L.F.						ACQUITTED	
TOTALS						CONVICTED	
DATE		PLACE				FINES	
LOCAL TRAFFIC OFFICER						IMPRISONMENT	
LOAD CONSISTED OF						SUSPENSION	
REMARKS:							

TRAFFIC REGULATION INSPECTOR



Plate LXXII. State Highway, Shasta County, bridge over Sacramento River,  
north of Redding.



Plate LXXIII. State Highway, Shasta County, bridge over Doney Creek,



Dependent upon the county traffic officers for the legal halting and weighing of vehicles on the state highways and, in case of violation of the load limits fixed by law, the issuance of legal citation to the offender to appear before the nearest justice for trial, there were times when the traffic regulation inspector and equipment were idle because a county traffic officer by reason of county needs was not available. To remedy this, the Chief of the Motor Vehicle Department was requested to appoint the five traffic regulation inspectors as field deputies, and this was done. The police power given proved of great value, permitting the traffic regulation inspectors to handle violations at all times and places and did away with enforced idleness.

At the beginning of patrolling in an assigned territory the work was largely educational, violators were informed of the legal load limits, minimum thickness of solid rubber tires and, in case of tractors, the permit requirements. Excess loads were removed or adjusted, a warning given the chauffeur or driver and the vehicle allowed to proceed. Solid rubber tires thinner than the legal minimum of one inch were put on an allowable load basis corresponding to metal tires. Apprehended violators were cited to appear for trial before the nearest local justice of the county in which the violation was found and a complaint was filed with the justice against the violator.

Of the number of convictions on complaints filed in justice courts there were two appeals to the superior courts. Both convictions resulted from charges of violations of the Motor Vehicle Act, to wit, overloading of trucks upon the public highways. The cases were argued and submitted together before the superior court in Los Angeles County. The defendants contended that conviction of exceeding "Weight limit per inch of tire width" imposed in section 15, paragraph C, of the Motor Vehicle Act, was illegal unless the total excess load was at least one full ton.

The superior court rendered decision affirming in each case the judgment of the court below and remittiturs were sent down to the justice court in due course. This decision clarified the situation and affirmed all convictions secured in justice courts on complaints charging loads on any solid rubber or metal tire in excess of the maximum legal limit.

Between December 5, 1921, and August 16, 1922, on which date traffic regulation work by the Highway Commission ceased, the amount of work done by the five traffic regulation inspectors is shown by the following tabulation.

TABLE OF OPERATIONS OF TRAFFIC REGULATION CREWS OPERATING UNDER THE JURISDICTION OF THE CALIFORNIA HIGHWAY COMMISSION, DECEMBER, 1921, TO AUGUST, 1922.

Period	No. of veh- icles	Vehicles Carrying overloads	Tire Overloads	Thin Tires	Tractors without permits	Overloads Adjusted & removed	Summons served	Con- victions	Total money penalties	Other penalties	Spending trucks & trailers	Cases pending or not reported.
	No.	%	No.	%	No.	%	No.	%				
Dec. 1921 to												
Feb. 28, 1922	195	24	12.31	79	40.51	5	2.56					
March	154	15	9.74	44	28.57	22	14.29					
April	89	6	6.74	41	46.07	10	11.23					
May	104	12	11.54	37	35.58	32	30.77					
June	126	16	12.70	53	42.06	52	41.27					
July	149	29	19.46	38	25.50	94	63.09					
August	97	16	16.49	31	31.96	60	61.86					
Totals	914	118	12.91	323	35.34	275	30.09	18				
								255	\$3617.25	43	16	19

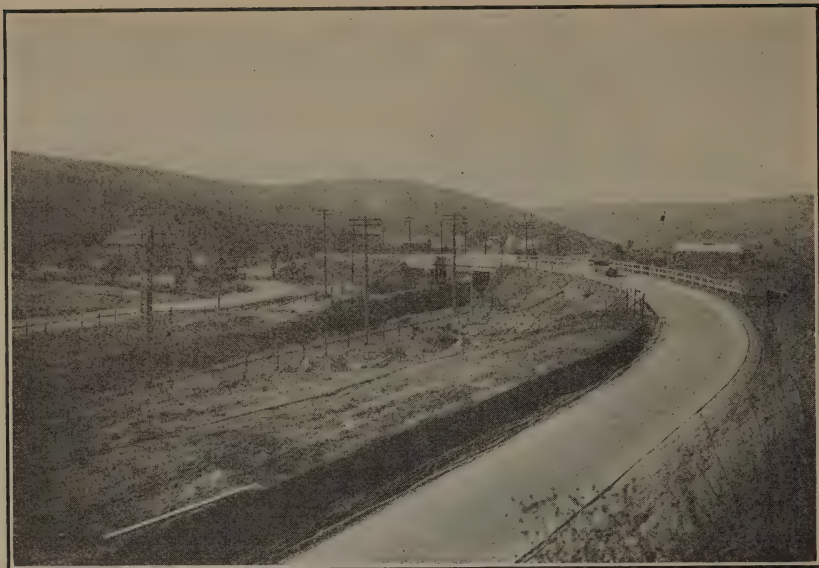


Plate LXXIV. State Highway, Alameda County, overhead crossing of Southern Pacific Railroad at Summit School, Altamont.



Plate LXXV. State Highway, Alameda County, overhead crossing of Southern Pacific Railroad in course of construction, between Altamont and Greenville.



It seems pertinent to record that county officials, particularly supervisors, are alive to the need for adequate policing of the highways against abuse and damage by motor trucks and other vehicles carrying illegal excess loads. A number of counties, following the lead of the Highway Commission, have put out similar equipment and are campaigning against overloaded vehicles.

The total working time for the five traffic regulation inspectors between December 5, 1921, and August 16, 1922, including all days, was 1149. This time was spent in constant patrolling of about 1500 miles of state highways, and included in addition visits to justice courts to file complaints and attendances before the court as prosecuting witness. Trucks, trailers and other vehicles were weighed, using loadometers.

Three hundred twenty-three overloads, either total or tire inch, and 275 tires thinner than the minimum allowed by law were discovered. Two hundred fifty-five convictions were secured and \$3,617.25 in fines was assessed by courts against the violators. There were also 23 suspended sentences. Many loaded vehicles were inspected, which did not indicate overloads and therefore were not weighed and no record made.

As a rule, only the rear end of the truck was weighed. The total load of 375 trucks was taken, however, and the distribution of gross load ascertained to be as follows:

Number weighed	Gross weight lbs. between	Per cent of load on rear end	Per cent of load on front end
4 trucks -----	0-10,000	79.94	20.06
152 trucks -----	10,000-20,000	74.51	25.49
148 trucks -----	over 20,000	75.73	24.27
71 trailers -----	4,600-22,600	55.76	44.24

The utmost courtesy toward the public was demanded of the inspectors employed on the work. The conduct of the work was clearly set forth in the following general instructions to the superintendent of traffic regulations:

"April 18, 1922.

MR. C. L. J. FROHWITTER,

Superintendent Traffic Regulations,  
Sacramento, California.

DEAR SIR: You and your assistants will please be governed by the following instructions in regard to conduct and enforcement of the provisions of the Motor Vehicle Act, relative to overloading of vehicles:

1. Provide yourself with a copy of the California Motor Vehicle Act as amended in 1919 and 1921, and thoroughly familiarize yourself with all of the paragraphs of section 15 and paragraphs (b) and (c) of section 22, which sections have to do with the permissible weights of vehicles and the speed limit of trucks.

2. Arrangements have been made to provide each one of your assistants with some means of motor transportation; also with a pair of loadometers and heavy jacks. One of the first duties of your inspectors should be to see that the speedometers on the motor vehicles accurately record the speed of the vehicle. This is very essential in connection with checking up the speed of trucks. The loadometers likewise should be checked at present by local representatives of the Sealer of Weights and Measures. Arrangements will be made soon for checking and adjusting all loadometers at headquarters in Sacramento. The loadometers and the speedometers on the motor vehicles should be checked periodically to insure that they do not become inaccurate.

3. Each inspector has been deputized by the Motor Vehicle Department. The object of so deputizing the Traffic Regulation Inspector is for the purpose of enabling him to make arrests when it is not possible to have the assistance of a local traffic officer. It is expected, however, that wherever possible, the assistance of the local authorities will be secured. In this way the work can be made more effective and if the arrest for violation is made by a local traffic officer, it will not as a rule be necessary for the Traffic Regulation Inspector to appear as a witness in the case and he will be free to proceed, unhampered by the necessity of adjusting his work to the convenience of the Court.

4. The utmost courtesy towards the public must be observed at all times by yourself and your assistants. It should be possible after a reasonable amount of experience for your assistants to judge somewhat as to the load of trucks and thus obviate the necessity of stopping and weighing a large percentage of trucks which are within the law.

The inspectors are expected to acquaint themselves with the average weights of farm produce and merchandise carried in containers of fixed size or volume habitually moved through their territory, so that they can by counting the number of packages or by sizing up the dimensions of a load arrive at an approximate estimate as to whether or not the vehicle is overloaded. In this way a great deal of annoyance will be saved to the public and the work of the inspector can be made more effective.

5. Trucks should be checked for speed, as well as for overloading, as heavily loaded trucks operating at speeds in excess of those permitted by the Motor Vehicle Act are the occasion of serious damage to the pavement.

6. Whenever the truck is not found to be overloaded on the rear end, it will not be necessary to weigh the front end. However, when the rear end is found to be overloaded, the front end must always be weighed and the loads on all four wheels shown on the record sent to this office.

In weighing trucks, care should always be taken to have the trucks as near level as possible, especially the two rear wheels.

7. In order not to place undue strain on the loadometers and also in order to make the work easier for the inspector, the trucks should be jacked up with the heavy jacks, the loadometer placed underneath the axle and the load eased onto the loadometer by lowering the jack. Place the loadometers under the axle as near as possible the same distance inside the wheel on each side. Use sufficient blocking under the base of the loadometer so that the screw is not unscrewed more than 1 to 1½ inches when the wheels are clear of the ground. Keep all working and bearing parts of the loadometers well oiled or greased.

8. Whenever a truck is found to be overloaded, the driver should be required to adjust the load, if possible, so as to secure a more uniform loading. If it is impossible to remove the overload on any one wheel by adjustment, the excess load should be entirely removed from the vehicle.

9. Trucks which are found to have insufficient rubber on the tires should be treated the same as all-metal-tired trucks and the load checked on the basis of 500 pounds per inch in width, instead of the 700 pounds per inch in width allowed for motor vehicles with solid rubber tires one or more inches in thickness; the speed limit for such trucks to be the same as the permissible speed limit for metal-tired vehicles.

10. When the vehicle is found to be but slightly overloaded, it will not be necessary to do any more than see that the load is properly adjusted and warn the offender that on the second offense, it will be necessary to arrest him. However, if the overloading is serious, arrest should be made even on the first offense and every effort made to secure conviction.

In general, it may be stated that minor violations of the provisions of the Motor Vehicle Act are not to be considered sufficient justification for Court action. Such action as may be necessary to put the load within the requirements of the law should be required of the driver and he should be instructed, cautioned, and allowed to proceed.

11. A book of "Traffic Regulation" report records will be furnished to each inspector. These records are to be made out in triplicate by the inspector, the original copy to be mailed direct to this office; the duplicate to be mailed to the Superintendent of Traffic Regulation, and the triplicate copy to be retained by the inspector for future reference.

12. Whenever a truck is weighed, the record should be made out immediately and mailed the same night to Sacramento. If an arrest is made, a subsequent report

should be made showing the ultimate disposition of the case. The second report should clearly indicate that a preliminary report has already been turned in.

13. Whenever an arrest is made, the number of the "Notice of Arrest" should be shown on the Traffic Regulation Records sent to this office.

Yours very truly,

THOS. E. STANTON,  
Assistant State Highway Engineer."

In 1922 the Attorney General's office is stated to have rendered an opinion that the appointment as field deputy of anyone not in the direct employ of the Motor Vehicle Department was illegal.

As this decision took away from the traffic regulation inspectors their power to stop and weigh trucks and also to make arrests, and it was not considered feasible to always have the service of a county traffic officer for the purpose, the California Highway Commission was forced to discontinue the work and disband the traffic regulation organization.



## APPENDIX I.

## BRIDGE WORK ON STATE HIGHWAYS.

By H. E. WARRINGTON, Assistant Highway Engineer.

In common with that of other departments, the work of this office has been considerably increased during the past two years. Much time has been given to the checking of plans submitted by the county authorities for bridges upon the state roads, and to their design by this department when this has been requested. In general, it is pleasant to record, there has been hearty cooperation with the Commission in making these county designs conform to modern requirements, but occasionally some disposition has been evinced to neglect conservative practice in favor of lower first cost.

It is, therefore, still believed that legal authority should be lodged with the Commission to require that the design of all structures on state highways shall accord with proper standards, and to compel close inspection during their building. The importance of the latter is not realized to the extent desirable. It is easily possible to vitiate the design in construction, especially in concrete structures, where improper placing of the steel, failure to hold it rigidly during the pouring of the concrete, or poor mixing or placing of the concrete may readily reduce the strength of the completed bridge to the danger point. All this requires inspectors of wide experience and sound judgment.

Much attention is necessary to what may seem minor details both in design and construction, or large expenditures will be necessary later in repairs. The building of concrete bridges is essentially a manufacturing process carried on in the field, whereas, for steel structures the fabrication has been attended to in shops fitted for it, and only the erection remains, usually a comparatively simple matter.

During the past two years the Commission has designed and built forty-nine bridges and other structures, at an aggregate cost of \$983,000, the bridges being well distributed over the state. In addition, plans have been finished and contracts let for twelve bridges and structures, now under construction. The contract cost of these structures is \$247,000. Plans for eleven bridges on the highways have been prepared for various counties at their request. The contract costs of these bridges is not known, but it is estimated at \$156,000. County plans for forty-five bridges have been checked by the Commission. The cost of these bridges is figured to be \$1,300,000. Plans have been practically completed by the Commission for eighteen other bridges, contracts for which can be let at an early date. The preliminary estimate for these bridges is \$700,000.

Some fifty special culverts, mostly under heavy fills, have been designed for different roads, and plans are under way for twenty-four more. These special culverts are of all sizes.

Five railway grade crossings have been done away with during the past two years, and plans are in preparation or completed for eight others. Notes upon these structures are given later. The work of elimi-

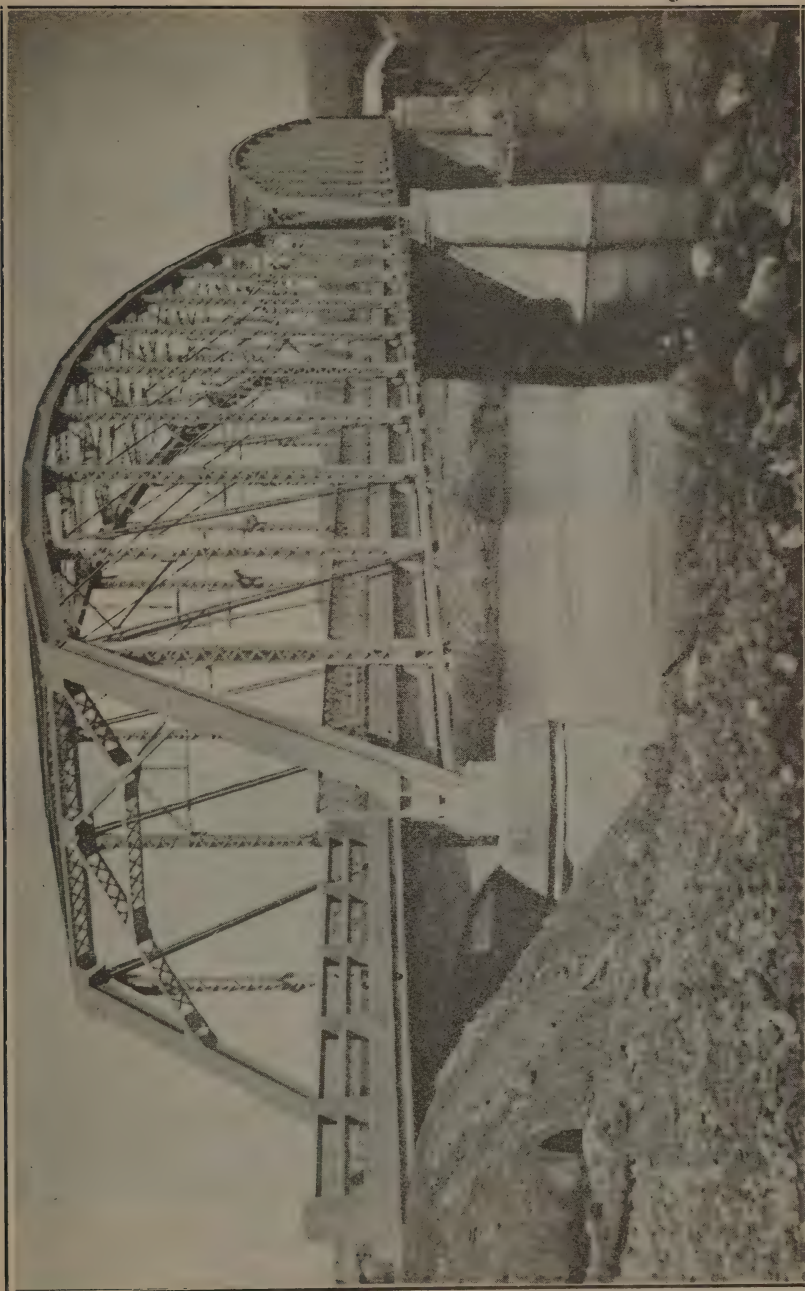


Plate LXXVI. State Highway, Butte County, bridge over Feather River.

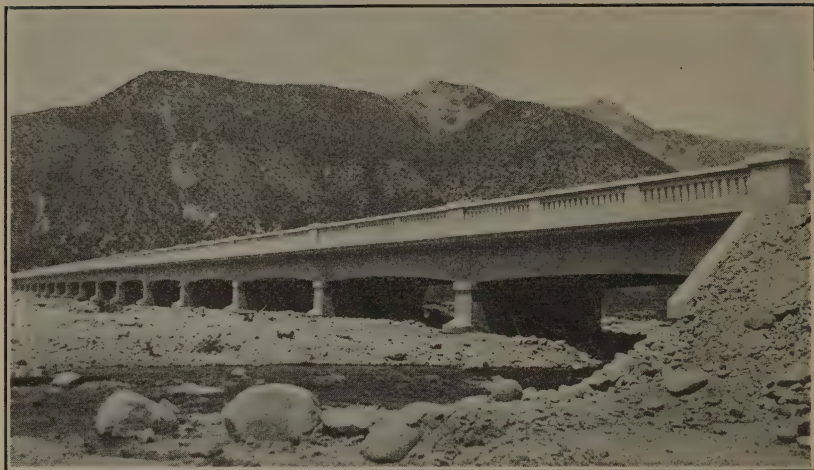


Plate LXXVII. State Highway, Los Angeles County, bridge over the North Branch of the Big Tujunga River.



Plate LXXVIII. State Highway, Los Angeles County, bridge over North Branch of Big Tujunga River, showing roadway.



nating dangerous grade crossings is being pushed as rapidly as funds will permit.

Some notes on a few of the larger structures designed by the Commission and completed during the past two years are here appended.

The bridge over the Feather River in Butte County on the Oroville lateral (Plate LXXVI) consists of two steel spans of 231 feet each, having a reinforced concrete floor upon which is placed an asphalt paving. On the easterly side is a creosoted pile trestle approach 647 feet long, and a concrete girder approach span 30 feet long is placed at the westerly end, avoiding a costly abutment, which would be necessary otherwise. The main steel spans rest upon concrete piers. The total length of the bridge is 1145 feet. Both approaches also have asphalt surfacing.

The bridge over the Rio Hondo in Los Angeles County, adjacent to Monterey Park (formerly Montebello), consists of four steel pony truss spans of 100 feet each, with a reinforced concrete approach span of 35 feet at each end. The concrete spans allow the approach fills to slope under them, eliminating expensive abutments. The steel spans have reinforced concrete floors, and the whole is surfaced with asphalt. The spans rest upon reinforced concrete piers, carried some 20 feet below the river bed and resting on wood piles. The total length of the bridge is 480 feet.

As a matter of historical interest the following is added concerning the structure replaced by this bridge.

The old bridge included two combination wood and steel spans, each 80 feet long on steel cylinder piers, and there were wooden approach trestles at each end. The total length of this old structure was approximately 740 feet. On October 14, 1920, this bridge was entirely destroyed, a camper's fire spreading to dry underbrush near the structure having ignited it. A high pressure gas main on the bridge made it impossible to control the fire until the bridge was consumed.

The traffic over this structure is very heavy, as it is on the main route between Los Angeles and San Diego.

The bridge over the north branch of the Big Tujunga (Plates LXXVII, LXXVIII), also in Los Angeles County, consists of sixteen reinforced concrete girder spans of 54 feet each. The spans rest upon plain concrete piers and abutments. The total length of the bridge is 869 feet.

The Bear Gulch bridge, in Humboldt county (Frontispiece), mentioned in the last biennial report, has now been completed. It consists of a reinforced concrete arch span of 128 feet with reinforced concrete approach spans, its total length being 247 feet. It is over a deep narrow arroyo, with rocky sides. The roadway is approximately 120 feet above the bottom of the arroyo.

The bridge over the Middle Fork of the Yuba River (Plate LXXX) in Nevada and Yuba counties was built by the Commission's forces. It is a reinforced concrete arch span 132 feet long, with concrete girder approach spans at each end, the total length being 200 feet.

In Nevada County is the bridge over the South Fork of the Yuba River (Plate LXXIX), also built by the Commission's forces. It is a single reinforced concrete arch span of 120 feet, with concrete girder approaches at each end; its total length is 199 feet.

The bridge over the Salinas River near King City is now completed and opened to traffic.

Under contract, but not yet finished, are three bridges on the Cuyama lateral in San Luis Obispo and Santa Barbara counties. These are over Huasna Creek (two steel pony truss spans of 100 feet each); Alamo Creek (of the same general plan as Huasna Creek), and across the Cuyama River, a steel truss span of 200 feet, with reinforced concrete girder approach spans, the total length of bridge being 356 feet.

#### BRIDGE PLANS COMPLETED OR UNDER WAY.

In addition to the above work, plans have been completed or are under way for several important bridges, among which is that over the San Gabriel River in Los Angeles County, made up of eighteen spans of 54 feet each, reinforced concrete girders, upon plain concrete piers. The new bridge replaces an old structure of wood and steel, but is located upon a revised line, about a quarter mile below the old bridge. Its total length is 1004 feet.

In San Joaquin County, plans are well along towards completion for a new bridge over the San Joaquin River. This bridge will contain a draw span 250 feet long, having concrete floor, and with reinforced concrete girder approach spans. The total length of the bridge will be 554 feet. The general plan has been approved by the government, and its building authorized by the Secretary of War.

Considerable study has been given to plans for a long reinforced concrete viaduct in Sacramento County, north of the American River, and across its overflow channel. The design is complicated by two railroad crossings, and the plans have not yet reached a final stage, as changes in this overflow channel are contemplated by the Reclamation Board.

#### OVERHEAD AND SUBWAY CROSSINGS.

The undergrade crossing of the Southern Pacific Railroad near Red Bluff in Tehama County has now been completed. This eliminates a very bad grade crossing where a number of accidents have occurred.

The undergrade crossing of the Northwestern Pacific Railroad near Arnold in Mendocino County has now been finished (Plate LXXXIII).

A crossing over the San Diego and Arizona Railway in San Diego County, near Jacumba, has been completed, doing away with a grade crossing at this point, which was particularly dangerous, as the railway approach to it was through a deep cut, and trains could not be seen until they were close to the crossing.

The undergrade crossing of the Western Pacific Railroad near Overacker, in Alameda County, has also been finished (Plate LXXXIV).

Negotiations with the Southern Pacific Railroad for an undergrade crossing near Cottonwood in Shasta County have been concluded, and this work is expected to be finished later in the year. The same is true of an undergrade crossing of the Southern Pacific Railroad near Redding, in Shasta County.

The overhead crossing of the Northwestern Pacific Railroad near Lytton, in Sonoma County, has been authorized by the Railroad Commission and work upon this is expected to be begun before the close of the year.



Plate LXXIX. State Highway, Nevada County, bridge over South Fork Yuba River.



Plate LXXX. State Highway, Yuba-Nevada Counties, bridge over Middle Fork Yuba River.



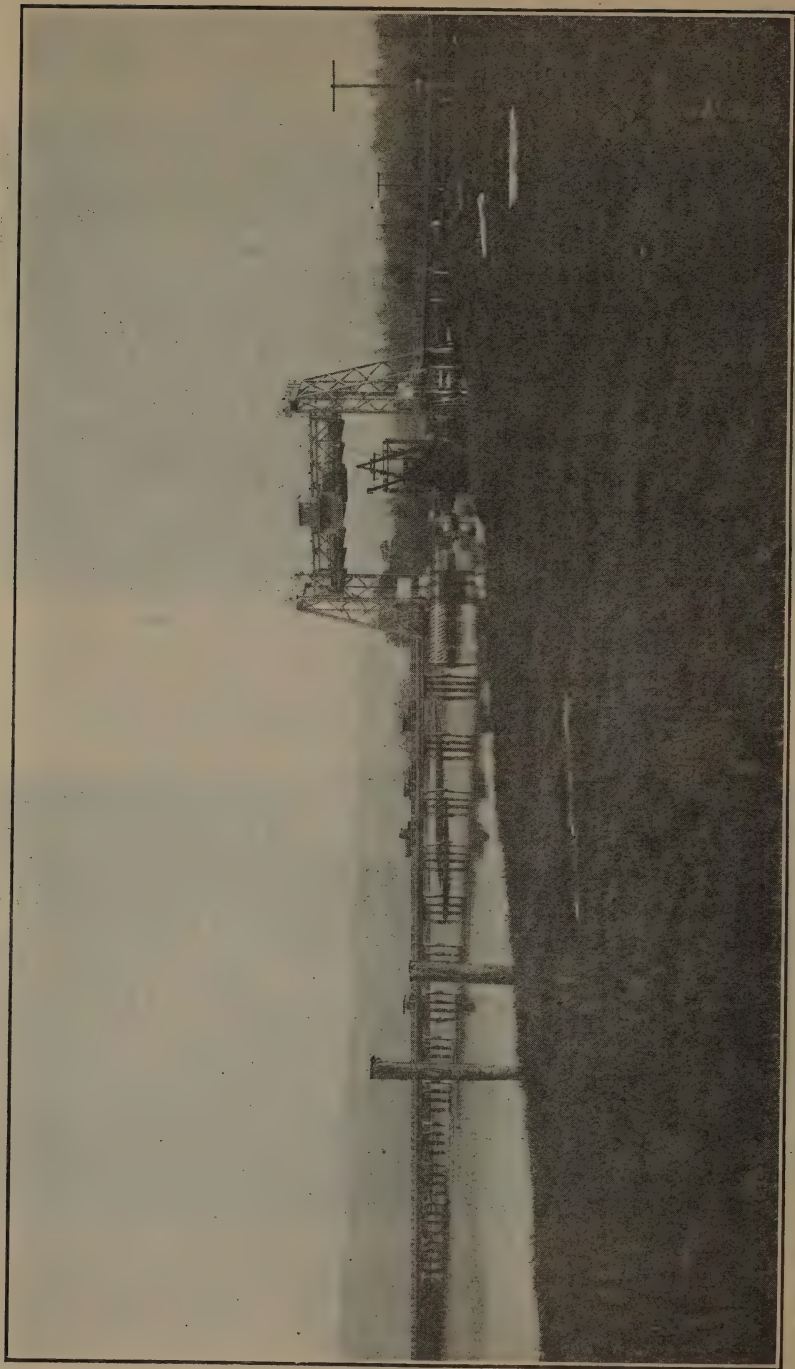


Plate LXXXI. State Highway, Humboldt County, bridge across Eureka Slough, showing lift span open.

The overhead crossing of the Southern Pacific Railroad east of Altamont has now been completed. (Plate LXXIV). That west of Altamont is under construction. (Plate LXXV). Both crossings are in Alameda County.

The plans for the elimination of a grade crossing of the Southern Pacific Railroad near Fredonia in Lassen County have been completed, together with those for the requisite bridge over the Susan River at this place, and it is expected that a contract for the work will soon be let.

A general plan for an overhead crossing of the San Francisco-Sacramento electric railroad near Denverton, in Solano County, has been submitted to the Railroad Commission. Their decision, permitting its construction and apportioning the cost thereof between the state and the railroad has been rendered, and detail plans of the necessary structure will soon be undertaken.

General plans for an undergrade crossing of the Northwestern Pacific Railroad near Alta in Marin County have been submitted to the Railroad Commission, but its decision thereon has not yet been made.

Preliminary studies for separation of grades of the highway and the Southern Pacific Railroad at five points in Placer County, near Bowman and Applegate, have been made, but no further work thereon has been done as yet.

## APPENDIX K.

## TESTING AND RESEARCH LABORATORY.

C. S. POPE, Assistant Highway Engineer.

F. T. MADDOCKS, Testing Engineer (Physical).

G. H. P. LICHTHARDT, Testing Engineer (Chemical).

Previous to the creation of the Department of Public Works, the examination and testing of materials by the California Highway Commission related largely to those materials encountered or used in highway construction.

After the organization of the Department of Public Works, however, the chemical testing laboratory, which up to that time had been under the jurisdiction of the State Purchasing Agent and which was principally employed in making chemical analyses of materials and supplies purchased for the various state institutions, was by arrangement placed under the jurisdiction of the Director of Public Works.

In order to properly house and centralize the testing and research work, the California Highway Commission has erected and equipped a building to be known as the testing and research laboratory.

This structure is a Class A building of brick, one story in height, with a spacious basement, and covers an area approximately 33 feet in width by 105 feet in length, and is set in a plot of ground approximately 272 feet long by 50 feet in width.

The main floor is occupied by a centrally located office with physical and chemical laboratories occupying the wings, and the blue print establishment a room in the rear.

The basement is devoted to the photostat department and to storage purposes.

The laboratories are well equipped with all necessary instruments to insure efficient handling of the work to be done.

**PHYSICAL TESTING LABORATORY.**

This laboratory controls materials used in highway construction throughout the entire state, and also makes physical tests of construction materials for all state departments.

Since its organization in May, 1912, the scope of work handled by this department has been so complete that records exist of materials from practically all usual sources of supply in the state.

In addition, a considerable amount of research work has been done from time to time.

Extensive experiments have been made relating to the action of alkali soils on cement concrete and asphaltic concrete, and some experiments also on the proper treatment of adobe and other adverse soils.

Numerous tests have been made of reinforced concrete slabs of various thicknesses, compositions, and differing arrangements of steel.

The effect of adulterants of various kinds has been given some attention in connection with concrete tests.



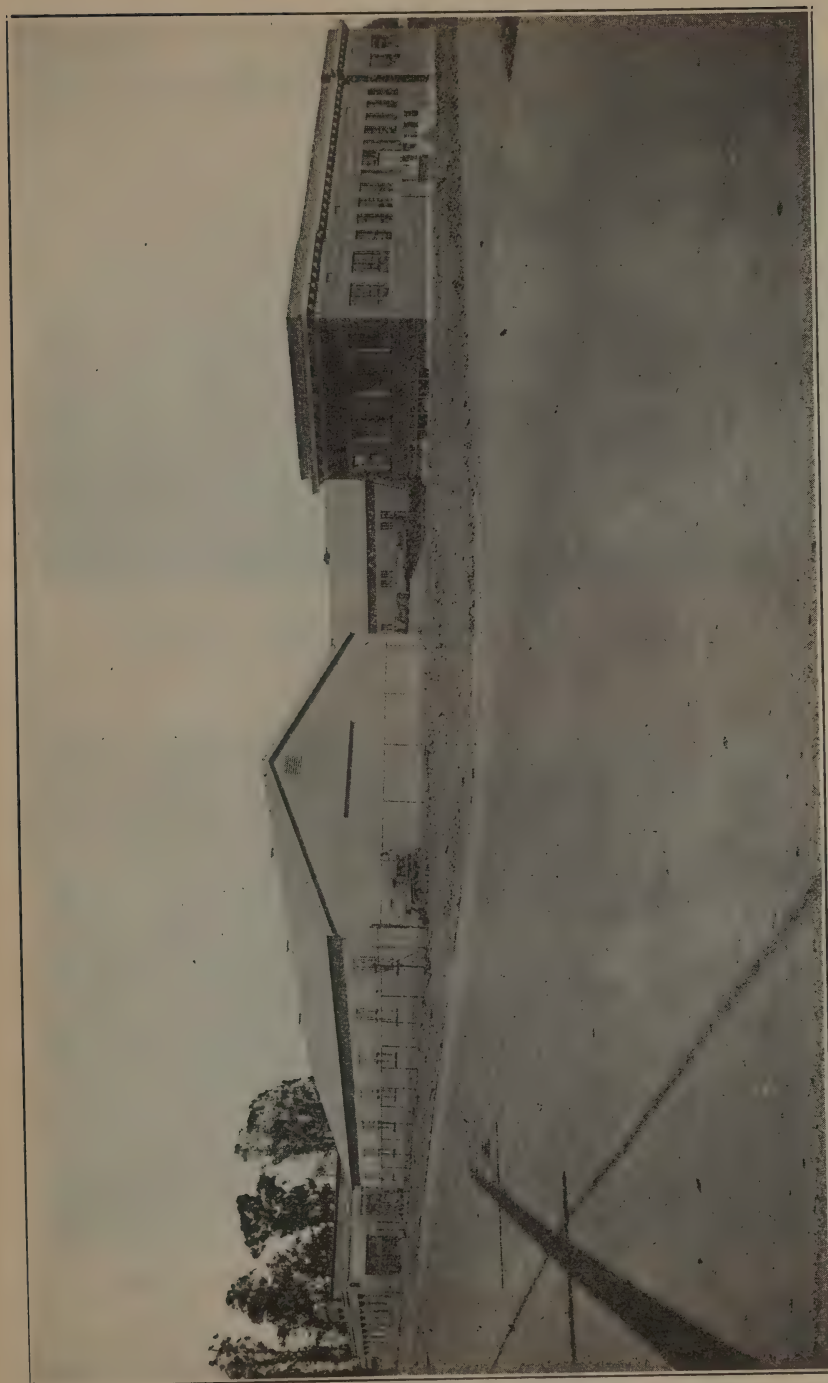


Plate LXXXII. California Highway Commission, testing laboratory, warehouses and repair shop buildings, Sacramento.



Plate LXXXIII. State Highway, Mendocino County, showing Arnold undergrade crossing of Northwestern Pacific Railroad.



Plate LXXXIV. State Highway, Alameda County, showing undergrade crossing of Western Pacific Railroad.

Materials from all work are tested with a frequency conforming to federal aid regulations and all tests are governed by the A. S. T. M. standards.

The minimum requirements governing tests of materials used in federal aid road construction are as follows:

#### DETERMINATION FOR QUALITY.

Portland cement -----	a. Sample from each car or its equivalent, or
	b. If bin tested, requirements of A. S. T. M. standard Test, C 9-17 govern.
Paving brick -----	a. Sample from each car or its equivalent, or
	b. If plant sampled, 3 tests from each kiln, or pile.
Bituminous materials -----	a. Sample from each car or its equivalent, and
	b. Sample each day from each kettle for consistency.
Bituminous concrete sheet asphalt	a. Sample of mix from each day's run.
Rock -----	a. Prior to use unless from a quarry tested within two years.
Slag -----	a. Prior to use in all cases.
Gravel or sand -----	a. Prior to use when intended as concrete aggregate.
Culvert metal -----	a. One sample from each 10 culverts.
	b. Not less than 3 samples from any one shipment.
Reinforcing steel -----	a. Sample of each size bar from each consignment.
	b. Sample of mesh reinforcement from each consignment.
	c. In lieu of (a) and (b) steel may be sampled at mill in which case A. S. T. M. Standard Test A 15-14 or A 16-14 are to govern.

#### DETERMINATION FOR SIZE.

Crushed stone, slag, gravel and sand for cement concrete, bituminous concrete, and sheet asphalt pavements -----	a. Composite sample from each consignment. No sample to represent more than 100 cubic yards and
	b. In the case of bituminous concrete and sheet asphalt daily determinations on total mineral aggregate also to be made.
Mineral filler -----	a. Sample from each consignment. No sample to represent more than 200 barrels.

During the year 1922 a large increase in asphaltic surfacing made necessary an expansion in personnel of this department and the work is now as thoroughly organized in the field and at the laboratory as any other part of the work.

Field engineers are equipped with scales, sieves, thermometers and other equipment necessary for field examination of materials at paving plants.

Samples of asphaltic cements and asphaltic mixtures are forwarded to the laboratory daily, together with complete reports of plant procedure and road progress.

The laboratory equipment comprises the usual cement testing equipment and in addition two compression machines of 50,000 and 200,000 pounds capacity, respectively.



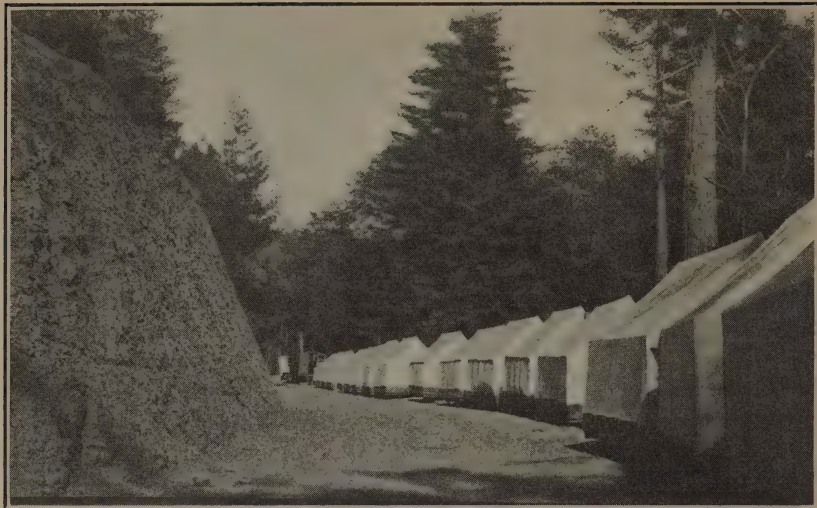


Plate LXXXV. State Highway construction camp, Mendocino County.



Plate LXXXVI. State Highway construction camp, Los Angeles County.

Preliminary sieving is done by means of a mechanical sieving machine, and asphaltic mixtures are handled by two Rotarexes of 50 and 1000 grammes capacity.

A Deval abrasion machine is used for rock tests and carborundum saws for sawing samples of cement concrete or asphaltic concrete. Asphaltic work is handled with the usual standard equipment.

Tests of corrugated metal pipe are made for weight and for spelter coating only at the present time.

The volume of the work has increased so greatly during the years 1920-22 that the force in this department now consists of the testing engineer and five assistants.

The amount of work done in the last biennium practically equals the total work done up to the year 1920, as shown by the following tabulation:

	1912-1920	1920-1922
Sand -----	985	955
Gravel -----	357	
Rock -----	270	753
Cement concrete -----	1,796	1,504
Asphaltic mixtures -----	1,004	1,140
Portland cement -----	4,000	3,000
Asphaltic cement -----	1,700	600
Corrugated metal -----	130	276
Steel -----	None	None

#### CHEMICAL TESTING LABORATORY.

This department on request makes analyses of materials purchased by the State Purchasing Department and by the various state institutions. Samples of coal, fuel oils, paints, grease, lubricating oils, varnish, leather, cloth, paper, and the numerous varied materials required by the different departments are submitted to this laboratory for test and the state thereby assured that materials will conform to specification requirements.

A great many of the articles now purchased by the state are purchased under specifications framed by this department and the system is rapidly being extended.

Coal and fuel oil, for instance, are purchased on a B.T.U. rating.

The force in this laboratory consists of the chemical engineer and two assistants and the laboratory is well equipped for the work it has to do. During the last biennium this department reported on some 1200 tests.

#### BLUE PRINT DEPARTMENT.

This department is equipped with an electric blue print machine. The volume of work handled by the department requires the employment of two men. These men are capable of turning out work equal to that of privately operated plants at a considerable saving in cost.

The monthly output of blue prints aggregates approximately 20,000 square feet and the cost is somewhat less than two cents per square foot.

Work is done for all state departments and both blue prints and blue line prints are turned out expeditiously and regardless of weather conditions.

#### **PHOTOSTAT DEPARTMENT.**

This department is equipped with an Eastman photostat and is engaged in reproducing title sheets, maps, tracings, drawing, etc., at a convenient size for use in office and field, and other work of similar character. One of its principal functions is the reproduction of documents, photographs, and general photographic work.

Since the organization of the Department of Public Works the work of the photostat department has increased considerably and two men are now required to handle the work.



APPENDIX L.

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STATE HIGHWAY BOND SALES.

## FIRST STATE HIGHWAY BONDS SOLD.

\$18,000,000

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
1-150	\$150,000	10/21/11	N. W. Halsey and Company		
151-300	150,000	10/21/11	Anglo-London-Paris National Bank		
301-400	100,000	12/ 5/11	State of California	7/ 3/14	School Fund
401-450	50,000	12/ 5/11	Sacramento Valley Bank and Trust Company		
451-650	200,000	8/29/12	Los Angeles Trust and Savings Bank		
651-700	50,000	8/13/12	Wells Fargo National Bank		
701-704	4,000	9/23/12	D. O. Mills and Company		
705-714	10,000	9/25/12	J. B. Topfitz		
715-800	88,000	10/ 4/12	Sacramento Valley Bank and Trust Company		
801-900	100,000	7/29/12	E. H. Rollins and Sons		
901-1000	100,000	7/12/12	D. O. Mills and Company		
1001-1100	100,000	7/18/12	Anglo-London Paris National Bank		
1101-1150	50,000	10/ 3/12	California National Bank		
1151-1200	50,000	7/23/12	N. W. Halsey		
1201-1350	150,000	7/18/12	Anglo-London Paris National Bank		
1351-1400	50,000	7/29/12	E. H. Rollins and Sons		
1401-1550	150,000	7/23/12	N. W. Halsey		
1551-1600	50,000	7/12/12	D. O. Mills and Company		
1601-1610	10,000	11/21/12	E. H. Rollins and Sons		
1611-1620	10,000	12/ 5/12	Wm. McLean		
1621-1625	5,000	12/ 5/12	Ida M. Smith		
1626-1630	5,000	12/ 5/12	Willis Smith		
1631-1730	100,000	12/14/12	N. W. Halsey		
1731	1,000	12/19/12	F. R. Sumner		
1732-1778	47,600	1/22/13	Sacramento Valley Bank and Trust Company		
1779-1780	2,000	1/30/13	Mrs. F. R. Sumner		
1781-1980	200,000	1/30/13	Hibernia Savings and Loan Society		
1981-1984	4,000	1/30/13	Consuelo Supreme Da U. P. E. C.		
1985-2000	16,000	2/15/13	N. W. Halsey and Company		
2001-2250	250,000	2/ 13	Security Trust and Savings Bank, Los Angeles		
2251-2400	150,000	2/ 13	First National Bank Los Angeles		
2401-2450	50,000	3/ 7/13	Bank of Italy		
2451-2500	50,000	3/11/13	German Savings and Loan Society, San Mateo		
2501-2520	20,000	6/16/13	California National Bank, San Bernardino		
2521-2525	5,000	6/16/13	California National Bank		
2526-2528	3,000	3/10/13	Mrs. F. R. Sumner, San Bernardino		
2529-2558	30,000	3/29/13	Wells Fargo National Bank, Santa Clara		
2559-2585	27,000	4/12/13	E. D. Roberts a/c S. F. Seawall Sinking Fund		

2586-2605	20,000	4/18/13	Bank of Ukiah, Mendocino
2606-2607	2,000	4/26/13	D. O. Mills and Company, San Bernardino
2608-2617	80,000	5/13/13	First National Bank, San Diego
2618-2700	13,000	5/27/13	First National Bank, Rialto, San Bernardino
2701-2720	20,000	11/1/13	E. D. Roberts a/c S. F. Seawall Sinking Fund
2721-2795	75,000	2/21/14	Citizens National Bank, Riverside
2796-2800	5,000	3/ 5/14	San Francisco Seawall Sinking Fund
2801-2900	100,000	4/11/13	Associated Banks, Humboldt
2901-3000	100,000	4/11/13	Hibernia Savings and Loan, San Mateo
3001-3010	10,000	3/13/13	California National Bank
3011-3017	7,000	3/18/13	California National Bank
3018-3039	22,000	3/20/13	California National Bank
3040	1,000	3/20/13	California National Bank
3041-3047	7,000	4/22/13	Sacramento Valley Bank and Trust Company
3048-3062	15,000	4/23/13	California National Bank
3063-3082	20,000	4/24/13	California National Bank
3083-3089	7,000	5/ 5/13	California National Bank
3090-3104	15,000	5/ 5/13	Miersen Banking Company, Placerville
3105-3115	10,000	12/ 2/13	Alameda County
3116-3125	10,000	2/11/14	State of California
3126-3200	75,000	1/ 3/14	State of California
3201-3400	200,000	4/24/13	Associated Banks, Orange
3401-3402	2,000	4/24/13	Mayfield Bank and Trust
3403-3413	11,000	4/23/13	Bank of Los Gatos
3414-3463	50,000	4/28/13	First National Bank, San Jose
3464-3501	38,000	5/ 9/13	Bank of San Jose
3502-3511	10,000	7/16/13	Garden City Bank and Trust Company
3512-3518	7,000	4/22/13	Bank of Sunnyvale
3519-3525	7,000	4/21/13	Bank of Campbell
3526-3527	2,000	5/ 3/13	First National Bank, Gilroy
3528-3530	3,000	4/23/13	Bank of Morgan Hill
3531-3534	4,000	6/18/13	Mission Bank, Santa Clara
3535-3548	14,000	4/18/13	Bank of Gilroy
3549-3558	10,000	4/23/13	Bank of Hopland, Mendocino
3559-3633	75,000	4/25/13	Peoples Bank, Santa Cruz
3634-3903	270,000	4/26/13	Los Angeles Banks, Los Angeles
3904-3908	5,000	4/30/13	State Bank, Dunsmuir, Shasta
3909-3923	15,000	5/13/13	First National Bank, Salinas, Monterey
3924-4000	77,000	5/13/13	First National Bank, San Diego
4001-4100	100,000	6/27/13	Central National Bank, Oakland
4101-4110	10,000	7/17/13	First National Bank, Hollister, San Benito
4111-4125	15,000	7/17/13	Bank of Hollister, San Benito
			S. F. Seawall Sinking Fund
			Teachers Salary and Retirement Fund



## FIRST STATE HIGHWAY BONDS SOLD—Continued

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
4126-4140	15,000	6/18/13	Salinas City Bank	-----	-----
4141-4155	15,000	6/19/13	Monterey County Bank	-----	-----
4156-4180	25,000	12/ 2/13	Alameda County	-----	-----
4181-4230	50,000	7/ 1/13	Safe Deposit Bank, San Jose, Santa Clara	-----	-----
4231-4270	40,000	10/ 1/13	E. D. Roberts, San Bernardino	-----	-----
4271-4295	25,000	10/14/22	Commercial Bank, Santa Barbara	-----	-----
4296-4298	3,000	10/18/22	First National Bank, Paso Robles, S. L. O.	-----	-----
4299-4309	11,000	10/18/22	Union National Bank, San Luis Obispo	-----	-----
4310-4345	36,000	10/18/22	Commercial Bank, San Luis Obispo	-----	-----
4346-4360	15,000	11/ 6/13	Supervisor, Mendocino County	-----	-----
4361-4380	20,000	11/11/13	Colony Holding Corporation, San Luis Obispo	-----	-----
4381-4400	20,000	11/ 7/13	Supervisors, San Luis Obispo	-----	-----
4401-4450	50,000	10/18/13	Commercial Bank, Santa Barbara	-----	-----
4451-4485	35,000	10/20/13	Commercial Bank, Santa Barbara	-----	-----
4486-4565	80,000	11/10/13	Colony Holding Corporation, San Luis Obispo	-----	-----
4566-4645	80,000	11/ 7/13	Supervisors, San Luis Obispo	-----	-----
4646-4660	15,000	10/24/13	Commercial Bank, San Luis Obispo	-----	-----
4661-4667	7,000	10/28/13	Jamestown National Bank, Tuolumne County	-----	-----
4668-4674	7,000	10/28/13	First National Bank, Jamestown, Tuolumne Co.	-----	-----
4675-4824	150,000	11/18/13	Fresno County	-----	-----
4825-4924	100,000	12/ 4/13	Contra Costa County	-----	-----
4925-5074	150,000	12/ 2/13	Alameda County	-----	-----
5075-5124	50,000	11/20/13	Siskiyou County	-----	-----
5125-5134	10,000	12/ 1/13	First National Bank, Santa Barbara	-----	-----
5135-5159	25,000	11/25/13	Title Insurance and Trust Company, Los Angeles	-----	-----
5160-5165	6,000	11/20/13	Central Bank, Santa Barbara	-----	-----
5166-5176	11,000	11/20/13	First National Bank, Tuolumne County	-----	-----
5177-5190	14,000	12/ 2/13	Alameda County	-----	-----
5191-5200	10,000	12/ 4/13	Contra Costa County	-----	-----
5201-5390	190,000	12/22/13	Contra Costa County	-----	-----
5391-5590	200,000	1/ 8/14	Kern County	-----	-----
5591-5605	15,000	1/ 7/14	San Bernardino Savings Bank, San Bernardino	-----	-----
5606-5655	50,000	2/ 5/14	Imperial County	-----	-----
5656-5705	50,000	2/13/14	Sacramento Clearing House, Yolo	-----	-----
5706-5775	70,000	2/20/14	Merced County	-----	-----
5776-5782	7,000	3/ 6/14	San Diego County	-----	-----
5783-5800	18,000	3/ 5/14	Glenn County	-----	-----

5801-6000	3/ 5/14	Glenn County	200,000
6001-6400	2/13/14	Sacramento Clearing House, Yolo	400,000
6401-6450	2/20/14	Merced County	50,000
6451-6500	3/13/14	Imperial County	50,000
6501-6550	3/ 4/14	Marin County	50,000
6551-6675	3/ 2/14	Colusa County	125,000
6676-6700	3/ 6/14	San Diego County	25,000
6701-6800	3/ 4/14	Marin County	100,000
6801-6883	3/ 6/14	San Diego County	83,000
6884-7000	3/ 3/14	Shasta County	117,000
7001-7083	3/31/14	Shasta County	83,000
7084-7200	4/ 4/14	Tehama County	117,000
7201-7375	4/ 2/14	Butte County	175,000
7376-7525	4/ 3/14	Ventura County	150,000
7526-7540	4/ 7/14	Tehama County	15,000
7541-7600	4/ 3/14	Kern County	60,000
7601-7750	3/31/14	Solano County	150,000
7751-7950	4/ 7/14	Tehama County	200,000
7951-8000	3/31/14	Siskiyou County	50,000
8001-8100	3/31/14	San Benito County	100,000
8101-8300	4/17/14	Orange County	200,000
8301-8500	4/ 9/14	Alameda County	200,000
8501-8650	3/31/14	Humboldt County	150,000
8651-8870	4/17/14	Sonoma County	220,000
8871-9020	5/ 3/14	Kern County	150,000
9021-9120	6/12/14	Santa Clara County	100,000
9121-9160	6/12/14	Santa Clara County	40,000
9161-9200	4/18/14	Tuolumne County	40,000
9201-9218	6/16/14	Tehama County	18,000
9219-9230	6/17/14	San Francisco Seawall Sinking Fund	12,000
9231-9275	6/12/14	Santa Clara County	45,000
9276-9400	5/26/14	Santa Clara County	125,000
9401-9450	5/25/14	Yolo County	50,000
9451-9850	4/18/14	Santa Barbara County	400,000
9851-10000	3/31/14	Hibernia Savings and Loan Bank, Yolo	150,000
10001-10075	2/ 5/15	Mendocino County	75,000
10076-10115	3/25/15	Yuba County	40,000
10116-10265	6/16/14	Humboldt County	150,000
10266-10365	9/24/14	Los Angeles County	100,000
10366-10545	6/23/14	Kern County	180,000
10546-10645	8/28/14	Santa Clara County	100,000
10646-10675	10/31/14	Capital National Bank, Sacramento	30,000

## FIRST STATE HIGHWAY BONDS SOLD—Concluded.

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
10676-10800	125,000	9/24/14	Los Angeles County		
10801-10900	100,000	9/19/14	Hibernia Savings and Loan Bank, San Francisco		
10901-10950	50,000	10/16/14	Siskiyou County		
10951-10960	10,000	11/23/14	Solano County		
10961-10980	20,000	12/10/14	Colusa County		
10981-10995	15,000	8/11/14	Trinity County		
10996-11035	40,000	12/12/14	Sutter County		
11036-11055	20,000	12/23/14	Colusa County		
11056-11057	2,000	11/11/14	Sutter County		
11058-11082	25,000	11/19/14	Sutter County		
11083-11087	5,000	12/10/14	Colusa County		
11088-11100	13,000	11/30/14	Sutter County		
11101-11200	100,000	12/10/14	Colusa County		
11201-11300	100,000	11/ 9/14	Solano County		
11301-11384	84,000	11/23/14	Solano County		
11385-11434	50,000	12/24/14	Los Angeles County		
11435-11494	60,000	2/15/15	Imperial County		
11495-11590	96,000	12/29/14	Colusa County		
11591-11600	10,000	3/ 9/15	Imperial County		
11601-11875	275,000	12/24/14	Los Angeles County		
11876-11900	25,000	12/29/14	Siskiyou County		
11901-12000	100,000	1/29/15	Napa County		
12001-12075	75,000	1/ 2/15	Stanislaus County		
12076-12100	25,000	1/29/15	Napa County		
12101-12225	125,000	3/16/15	Monterey County		
12226-12250	25,000	2/17/15	Capital National Bank, Sacramento		
12251-12275	25,000	3/16/15	Stanislaus County		
12276-13000	725,000	1/ 3/15	State of California		
12276-12338				2/15/16	E. H. Rollins and Sons
12401-12600				2/15/16	E. H. Rollins and Sons
12601-12800				2/18/16	E. H. Rollins and Sons
12802-12900				2/15/16	E. H. Rollins and Sons
12901-13000				2/18/16	E. H. Rollins and Sons
12339-12400					
13001-13150	150,000	3/16/15	Humboldt County		
13151-13400	250,000	3/24/15	Monterey County		
13401-13500	100,000	4/ 5/15	Imperial County		
13501-13700	200,000	3/16/15	San Diego County		
13701-13950	250,000	3/16/15	Ventura County		



13951-14000	50,000	3/16/15	Kings County	-----	-----
14001-14150	150,000	8/ 7/15	Butte County	-----	-----
14151-14200	50,000	7/30/15	Mono County	-----	-----
14201-14235	35,000	7/28/15	Stanislaus County	-----	-----
14236-14335	100,000	6/15/15	Merced County	-----	-----
14336-14435	100,000	7/30/15	Inyo County	-----	-----
14436-14535	100,000	7/30/15	Placer County	-----	-----
14536-14670	135,000	8/ 3/15	San Luis Obispo County	-----	-----
14671-14705	35,000	8/11/15	Tulare County	-----	-----
14706-14760	55,000	8/ 3/15	Kings County	-----	-----
14761-14820	60,000	8/11/15	Imperial County	-----	-----
14821-14920	100,000	7/30/15	Placer County	-----	-----
14921-14970	50,000	7/31/15	Mendocino County	-----	-----
14971-15020	50,000	7/30/15	Placer County	-----	-----
15021-15170	150,000	8/ 5/15	Monterey County	-----	-----
15171-15200	30,000	11/10/15	Colusa County	-----	-----
15201-15290	90,000	11/10/15	Colusa County	-----	-----
15291-15315	25,000	7/30/15	Mendocino County	-----	-----
15316-15365	50,000	8/11/15	Mendocino County	-----	-----
15366-15415	50,000	8/11/15	Glenn County	-----	-----
15416-15595	180,000	8/11/15	Tulare County	-----	-----
15596-15630	35,000	8/ 3/15	National Bank, Sonora	-----	-----
15631-15680	50,000	8/ 3/15	San Diego County	-----	-----
15681-15730	50,000	6/30/15	Title Abstract Ins. and Trust Co. for Kern Co.	-----	-----
15731-15790	60,000	8/17/15	Santa Cruz County	-----	-----
15791-15990	200,000	7/28/15	Humboldt County	-----	-----
15991-16040	50,000	1/ 5/16	Humboldt County	-----	-----
16041-16290	250,000	7/30/15	Santa Barbara County	-----	-----
16291-16340	50,000	1/ 5/16	Humboldt County	-----	-----
16341-16365	25,000	8/11/15	Santa Barbara County	-----	-----
16366-16400	35,000	8/23/15	Santa Clara County	-----	-----
16401-16490	90,000	8/23/15	Santa Clara County	-----	-----
16491-16500	10,000	8/ 5/15	Monterey County	-----	-----
16501-18000	1,500,000	3/15/16	State of California, Surplus Fund	-----	-----
16501-16850	-----	-----	-----	-----	-----
Total issue--	\$18,000,000	-----	-----	-----	-----

Note:

16851-18000  
12801

Remains in surplus fund.

1,150,000 {  
1,000 }

Compens'n Insurance Fund

4/ 4/17

## SECOND STATE HIGHWAY BONDS SOLD.

\$15,000,000. Act, 1915.

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
1-3000	\$3,000,000	8/ 1/17	National City Company and E. H. Rollins	-----	-----
3001-3250	250,000	9/11/17	Teachers' Permanent Fund	-----	-----
3251-5000	1,750,000	9/ 8/17	National City Company	-----	-----
5001-5005	5,000	5/ 8/18	National Bank of D. O. Mills and Company	-----	-----
5006-5011	6,000	6/22/18	National Bank of D. O. Mills and Company	-----	-----
5012-5311	300,000	8/ 2/18	General Fund Surplus	10/19/18	Anglo - London - Paris Bank
5312-5316	5,000	8/ 8/18	H. J. Aden	-----	-----
5317-5516	200,000	8/17/18	General Fund Surplus	-----	-----
5317-5416	100,000*	-----	-----	10/19/18	Anglo - London - Paris Bank
5417-5516	100,000*	-----	-----	11/22/18	Anglo - London - Paris Bank
5517-5341	325,000	10/28/18	General Fund Surplus	-----	-----
5342-6041	200,000	11/25/18	General Fund Surplus	-----	-----
5517-5516	100,000*	-----	-----	-----	-----
5617-6041	425,000*	-----	-----	11/22/18	Anglo - London - Paris Bank
6042-6641	600,000	11/27/18	General Fund Surplus	11/29/18	Anglo - London - Paris Bank
6642-7116	475,000	11/29/18	Anglo-London-Paris Bank	11/29/18	Anglo - London - Paris Bank
7117-8141	1,025,000	1/15/19	General Fund Surplus	-----	-----
8142-8491	350,000	4/ 3/19	General Fund Surplus	-----	-----
8492-8500	9,000	4/22/19	General Fund Surplus	-----	-----
7951-8500	550,000*	-----	-----	4/22/19	Anglo - London - Paris Bank
7117-7466	350,000*	-----	-----	4/ 2/19	Anglo - London - Paris Bank
7467-7476	10,000*	-----	-----	5/16/19	Anglo - London - Paris Bank
7501-7750	250,000*	-----	-----	5/16/19	Anglo - London - Paris Bank
7477-7500	24,000*	-----	-----	5/20/19	Anglo - London - Paris Bank
7751-7760	10,000*	-----	-----	5/20/19	Anglo - London - Paris Bank
7761-7765	5,000*	-----	-----	5/21/19	Anglo - London - Paris Bank
7766-7775	10,000*	-----	-----	5/22/19	Anglo - London - Paris Bank
7787-7885	10,000*	-----	-----	5/23/19	Anglo - London - Paris Bank
7886-7935	50,000*	-----	-----	5/26/19	Anglo - London - Paris Bank
7778-7795	20,000*	-----	-----	5/31 19	Anglo - London - Paris Bank
7796-7875	80,000*	-----	-----	6/ 3/19	Anglo - London - Paris Bank
7936-7950	15,000*	-----	-----	6/ 3/19	Anglo - London - Paris Bank
8001-10000	1,500,000	4/10/19	General Fund Surplus	4/19/19	Anglo - London - Paris Bank
10001-10049	49,000	9/15/19	General Fund Surplus	9/15/19	Sacramento State Bldg. Fund
10050-10099	50,000	9/17/19	General Fund Surplus	9/19/19	Capital National Bank
10100-11099	1,000,000	9/30/19	General Fund Surplus	9/30/19	Capital National Bank

11100-11139	90,000	10/ 2/19	General Fund Surplus	-----	10/ 2/19	Bank of Gridley.
11139-11339	200,000	10/10/19	General Fund Surplus	-----	10/11/19	Bank of Italy
11339-12000	611,000	10/18/19	General Fund Surplus	-----	10/20/19	Bank of Italy
12001-12500	500,000	12/22/19	General Fund Surplus	-----	12/ 7/21	Anglo - London - Paris Bank
12501-12800	300,000	1/ 8/20	General Fund Surplus	-----	12/ 7/21	Anglo - London - Paris Bank
12801-13000	200,000	1/19/20	General Fund Surplus	-----	12/ 7/21	Anglo - London - Paris Bank
13001-13062						
13126-13313						
13501-13688						
13876-13937	1,000,000	12/17/20	General Fund Surplus	-----	12/17/20	Butte County
13938-14062						
14251-14438						
14626-14812						
13063-13125						
13314-13500						
13689-13875						
14063-14250						
14439-14625						
14813-15000						
	1,000,000	12/ 7/21	General Fund Surplus	-----	12/ 7/21	Anglo - London - Paris Bank

Total issue \$15,000,000

\*Bonds resold not included in total.

## THIRD STATE HIGHWAY BONDS SOLD.

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
3001-3500					
4001-4500					
5001-5500					
6001-6500					
7001-7500					
8001-8500					
378-382					
1377-1381					
2375-2379					
3698-3700					
4691-4693					
5687-5688					
6687-6688					
7691-7692					
8698-8700					
9375-9379					
10377-10381					
11378-11382					
1933-1937					
1926-1932					
384-389					
1383-1388					
2381-2387					
3702-3703					
4695-4696					
5690-5691					
6690-6691					
7694-7695					
8702-8703					
9381-9387					
10383-10388					
11384-11389					
	\$3,000,000	3/ 1/20	General Fund Surplus-----	3/ 1/20	Anglo - London - Paris Bank
	45,000	7/15/20	General Fund Surplus-----	7/15/20	Stanislaus County
	5,000	7/27/20	General Fund Surplus-----	7/27/20	Bank of Cambria, S.L.O. Co.
	7,000	7/27/20	General Fund Surplus-----	7/27/20	First National Bank of Monterey, Monterey County
	50,000	8/ 3/20	General Fund Surplus-----	8/ 3/20	Yolo County

\$40,000,000.



{ 330-401 1389-1401 2388-2400 3704-3707 4697-4700 5692-5695 6692-6695 7696-7699 8704-8707 9388-9400 10389-10401 11390-11401 }	100,000	8/ 5/20	General Fund Surplus-----	8/ 5/20	Tehama County
{ 383 & 1382 2380-3701 and 4694 }	5,000	8/ 6/20	General Fund Surplus-----	8/ 6/20	Modoc County
{ 5689-6689- 7693 }	3,000	8/ 6/20	General Fund Surplus-----	8/ 6/20	J. S. Potter
{ 402-413 1402-1413 2401-2414 3708-3711 4701-4704 5696-5699 6696-6699 7700-7703 8708-8711 9401-9414 10402-10413 11402-11413 }	100,000	8/10/20	General Fund Surplus-----	8/10/20	Anglo - London - Paris Bank
{ 8701 9380 10382 11383 }	4,000	8/24/20	General Fund Surplus-----	8/24/20	San Luis Obispo County.

## THIRD STATE HIGHWAY BONDS SOLD—Continued.

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
417-421	\$40,000	8/24/20	General Fund Surplus-----	8/24/20	Butte County
1417-1420					
2418-2421					
3714-3716					
4706-4707					
5701-5702					
6700-6701					
7705-7706					
8714-8716					
9418-9421					
10417-10420					
11417-11421					
414-416					
1414-1416	25,000	8/24/20	General Fund Surplus-----	8/24/20	Del Norte County
2415-2417					
3712-3713					
4705 -----					
7704 -----					
5700 -----					
8712-8713					
9415-9417					
10414-10416					
11414-11416					
422-424					
1421-1423					
2422-2424					
3717-3719	35,000	8/25/20	General Fund Surplus-----	8/25/20	Lassen County
4708-4710					
5703-5704					
6702-6704					
7707-7709					
8717-8719					
9422-9424					
10421-10423					
11422-11424					
425-430					
1424-1429					
2425-2431					
3720-3721					
	21,000	8/28/20	General Fund Surplus-----	8/28/20	Humboldt County

4711-4712	29,000	8/28/20	General Fund Surplus -----	8/28/20	Humboldt County
5705-5706					
6705-6706					
7710-7711					
8720-8721					
9425-9430					
10424-10429					
11425-11431					
431-475					
1430-1474					
2432-2476	500,000	9/10/20	General Fund Surplus -----	9/10/20	Los Angeles County
3722-3766					
4713-4747					
5707-5741					
6707-6741					
7712-7746					
8722-8766					
9431-9475					
10430-10474					
11432-11476					
477-483	50,000	9/15/20	General Fund Surplus -----	9/15/20	Yolo County
1476-1481					
2478-2483					
3767-3768					
4748-4749					
5742-5743					
6743-6744					
7747-7748					
8767-8768					
9476-9481					
10475-10481	3,000	9/15/20	General Fund Surplus -----	9/15/20	Plumas County
11477-11482					
476-1475					
2477 -----					
484-489					
1482-1488					
2484-2491					
3769-3770					
4750 -----					
5744 -----					
6742 -----	27,000	9/21/20	General Fund Surplus -----	9/21/20	Santa Cruz County
7749 -----					

## THIRD STATE HIGHWAY BONDS SOLD—Concluded.

Numbers	Amount	Original sale date	Purchaser	Resale date	Purchaser
8769-8770	23,000	9/21/20	General Fund Surplus-----	9/21/20	Santa Cruz County
9482-9489					
10482-10487					
11483-11489					
490-539					
1489-1538					
2492-2541					
3771-3810					
4751-4780					
5745-5774					
6745-6774	500,000	10/ 5/20	General Fund Surplus-----	11/ 4/20	Los Angeles County
7750-7779					
8771-8810					
9490-9539					
10488-10537					
11490-11539					
540-545					
1539-1543					
2542-2546					
3811-3813					
4781-4783	50,000	10/21/20	General Fund Surplus-----	10/21/20	Kern County
5775-5777					
6775-6777					
7780-7782					
8811-8813					
9540-9544					
10538-10542					
11540-11545					
546-605					
1544-1603					
2547-2606	500,000	11/ 4/20	General Fund Surplus-----	10/ 5/20	Los Angeles County
3814-3833					
4784-4808					
5778-5802					
6778-6802					
7783-7807					
8814-8833					
9545-9604					
10543-10602					
11546-11605					



1-377						
606-1228	1,000,000	5/10/21	Merced County			
2268-2374						
2607-2649	150,000	5/11/21	State School Land Fund			
2650-2699	50,000	5/11/21	Sacramento State Building Fund			
1229-1376						
1604-1925						
1988-2267	800,000	5/17/21	Kern County			
2700-3000						
3501-3697						
3834-4000						
4501-4690						
4809-5000						
5501-5686						
5803-6000						
6501-6686						
6803-7000						
7501-7690	4,873,000	7/19/21	Anglo-London-Paris Bank			
7808-8000						
8501-8697						
8834-9000						
9001-9374						
9605-10000						
10001-10376						
10603-11000						
11001-11377						
11606-12000						
12001-17000	5,000,000	11/ 1/21	Anglo-London-Paris Bank			
17001-24000	7,000,000	12/37/21	Anglo-London-Paris Bank			
Total--	\$24,000,000					

## APPENDIX M.

## ANALYSIS OF CEMENT PURCHASES 1920, 1921, 1922.

## ANALYSIS OF CEMENT PURCHASES IN YEAR 1920.

Contract Number	Date of Award	Quantity Bid on	Delivery Point	1	2	3	4	5	6	7	8	9	Quantity Delivered	Mill Base	Cost at Mill
C-242	June 6-19	1950	Palmer	2.78*	2.78*								243	2.10	505.10
C-243	June 22-19	24500	Mercer	2.59*	2.59*								16099	2.10	37766.90
C-244	June 22-19	2000	Tuttle	3.53	3.53*						2.59		400	1.96	784.00
C-245	Sept. 12-19	20500	Oriskany City	2.51*	2.51*							2.518	8183	2.09*	17128.83
C-246	Oct. 4-20	910	Oakdale		2.70**								910	2.70	2457.00
C-247	Oct. 23-19	19135	Acton		2.63*								20146	1.62*	36555.72
C-248	Dec. 3-19	11200	Ensign	2.72	2.63*								12527	2.06*	32537.70
C-249	Dec. 13-19	584	Campos		2.70**								434	1.81*	8981.15
C-250	Feb. 26-20	24530	Mecca		2.48*								28545	1.65	52908.25
C-251	Apr. 27-20	20000	Ronda		2.70**								8950	1.85	16576.00
C-252	Apr. 27-20	18430	Genesee		2.48*								20652	2.36	51364.95
C-253	Apr. 27-20	28575	Glennwood		2.69	2.42*							31119	2.10	65349.90
C-254	Apr. 27-20	25500	Joe Wolinos		2.70**								23477	2.45	72218.65
C-255	July 31-20	11900	Nelson		2.98*								15229	2.10	31980.30
C-256	Aug. 10-20	15435	Mecca	2.53	2.63*						1.893*		8995	2.31	20342.40
C-257	Aug. 3-20	5500	Campos		2.70**								2854	2.70	7975.80
C-258	Aug. 30-20	2354	Bakersfield		2.70**								15669	2.10	33324.90
C-259	Apr. 27-20	11900	South Bay		2.76*		2.75						1859	2.30	4275.70
C-260	Oct. 13-20	5974	Riverbank		2.63*								1015	1.978	2077.37
C-261	Oct. 23-20	1000	Riverbank		2.70**								30465	1.85	56360.25
C-262	Feb. 26-20	14050	Mecca		2.70**								1750	2.35	4112.50
C-263	Apr. 27-20	1625	Summerland		2.95								670	2.10	1407.00
C-264	Apr. 27-20	1335	Alhambra		2.97*		3.17						743	2.43	1656.59
C-265	June 30-20	800	Nevada City		3.45*		3.54						1435	2.35	3372.25
C-266	Sept. 27-20	960	Bakersfield		3.65								150	2.35	375.00
C-267	June 28-20	160	Lantersheim		2.70**								176	2.70	472.50
C-268	July 13-20	175	Howard		2.77*								2135	2.45	5019.60
C-269	Aug. 19-20	1950	Owensmouth		2.70**								3875	2.35	9108.50
C-270	Aug. 30-20	1870	Owensmouth		2.70**								205	2.40	492.00
C-271	June 4-20	205	Madrone		2.40**								319	2.70	815.10
C-272	Sept. 13-20	320	Freckett		2.70**								225	2.70	607.50
C-273	Sept. 13-20	655	Bakersfield		2.65*								1596	2.70	4309.20
C-274	Sept. 13-20	650	Bakersfield		2.70**								1000	2.70	2802.00
C-275	Sept. 13-20	1000	Owensmouth		2.70**								1685	2.70	4605.20
C-276	Oct. 23-20	550	Williams		2.70**								365	2.70	993.50
C-277	Oct. 23-20	620	Bakersfield		2.70**								522	2.70	1679.40
C-278	Oct. 23-20	600	Camallo		2.70**								507	2.70	1530.90
C-279	Oct. 23-20	570	Livermore		2.70**								160	2.35	375.00
C-280	Nov. 12-20	160	Dixieland		2.70**								170	2.15	365.50
C-281	Dec. 28-20	170	Prasco		2.70**								240	2.35	645.00
C-282	Dec. 28-20	313	Williams		2.70**								340	2.35	645.00
C-283	Dec. 28-20	240	Orcutt		2.70**								31204	2.158	67720.29
TOTALS															

\* Successful bidder

\* Mill Base Price

\* Emergency purchase; competitive bids not taken

\* For key to bidders see last page of "Analysis of Cement Purchases in Year 1921"

## ANALYSIS OF CEMENT PURCHASES IN YEAR 1921.

Contract Number	Date of Award	Quantity Bids on	Delivery Points	1	2	3	4	5	6	7	8	9	Quantities Delivered	Mill Base	Cost at Mill
C-250	Apr. 27-28	5900	Vina Bluff	3.73	3.16*	3.43		2.33*	2.35*	3.65	2.05*	3.63	9440	2.50	23600.00
C-251	Apr. 27-28	16804	Red Bluff	3.73	3.16*	3.43		2.33*	2.35*	3.65	2.05*	3.63	15500	2.50	21550.00
C-256	Apr. 9-10	18546	Coalinga	3.73	3.16*	3.43		2.33*	2.35*	3.65	2.05*	3.63	24490	2.50	21550.00
C-257	Apr. 1-21	25600	Red Bluff	3.73	3.16*	3.43		2.33*	2.35*	3.65	2.05*	3.63	23761	2.70	80408.70
C-279	Apr. 1-21	31568	Cottonwood	3.31	3.31	3.31		2.45*	2.45*	4.00	2.05*	3.91	23044	2.50	72510.00
C-279	Apr. 9-10	35500	Coalinga	4.01	3.99	3.99		2.03*	2.03*	3.85	2.05*	4.27*	44335	2.69	93078.15
C-281	Apr. 9-10	35500	Redwood	4.37	3.97	3.97		2.03*	2.03*	3.85	2.05*	4.27*	44335	2.69	93078.15
C-282	Apr. 9-10	3072	Oroville	3.42	3.42	3.42		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-283	Apr. 9-21	23040	Traso Robles	3.52	3.72	3.42*		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-284	May 25-26	12940	Urich	3.80	3.70	3.70		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-285	May 25-26	300	Aburn	3.80	3.70	3.70		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-286	May 25-26	304	Ida	3.80	3.70	3.70		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-287	May 25-26	304	Ida	3.80	3.70	3.70		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-288	May 25-26	29384	Ida	3.80	3.70	3.70		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-289	May 25-26	1654	Garfield	3.04	3.04	3.04		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-290	May 25-26	1654	Garfield	3.04	3.04	3.04		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-291	May 25-26	1654	Newark	3.33	3.33	3.33		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-292	May 25-26	1654	Ida	3.33	3.33	3.33		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-293	May 25-26	1654	Ida	3.33	3.33	3.33		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-294	May 25-26	1654	Ida	3.33	3.33	3.33		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-295	May 25-26	1654	Ida	3.33	3.33	3.33		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-296	June 21-21	285	Ida	3.72	3.72	3.72		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-297	June 21-21	1654	Anaconda	3.72	3.72	3.72		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-298	June 21-21	1654	Anaconda	3.72	3.72	3.72		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-299	June 21-21	1654	Anaconda	3.72	3.72	3.72		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-300	June 21-21	1654	Anaconda	3.72	3.72	3.72		2.45*	2.45*	3.85	2.05*	4.27*	23761	2.70	70360.50
C-301	June 14-21	225	Minden Nev.	2.70*	2.70*	2.70*		2.25*	2.25*	3.73	2.77	2.35*	225	2.70	607.50
C-302	June 14-21	225	Minden Nev.	2.70*	2.70*	2.70*		2.25*	2.25*	3.73	2.77	2.35*	225	2.70	607.50
C-303	June 14-21	225	Minden Nev.	2.70*	2.70*	2.70*		2.25*	2.25*	3.73	2.77	2.35*	225	2.70	607.50
C-304	June 14-21	225	Minden Nev.	2.70*	2.70*	2.70*		2.25*	2.25*	3.73	2.77	2.35*	225	2.70	607.50
C-305	July 11-21	720	Leopold	4.39	4.24	4.24		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-306	July 11-21	400	Leopold	4.39	4.24	4.24		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-307	July 11-21	352	Hemlock	3.36	3.36	3.36		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-308	July 11-21	352	Hemlock	3.36	3.36	3.36		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-309	Aug. 2-21	436	Lea	3.69	3.69	3.69		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-310	Aug. 2-21	330	Lea	3.69	3.69	3.69		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-311	Aug. 2-21	1169	Redding	3.40	3.40	3.40		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-312	Aug. 2-21	285	Susanville	4.18	4.18	4.18		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-313	Aug. 2-21	285	Susanville	4.18	4.18	4.18		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-314	Aug. 2-21	3600	Haitsburg	3.31	3.31	3.31		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-315	Aug. 2-21	1000	Ida	3.59	3.59	3.59		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-316	Oct. 10-21	1500	Ida	3.59	3.59	3.59		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-317	Oct. 10-21	1500	Ida	3.59	3.59	3.59		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-318	Nov. 28-21	180	Ida	3.59	3.59	3.59		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-319	May 25-21	28500	Ida	3.51	3.51	3.51		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-320	Oct. 28-21	6000	Gilroy	2.84	2.84	2.84		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-321	Nov. 28-21	335	Leopold	3.79	3.79	3.79		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75
C-323	Oct. 28-21	1750	Fairville	2.84	2.84	2.84		2.40*	2.40*	3.69*	2.55*	4.01	1075	2.25	2418.75

\* Successful Bidder

\* Mill Base Price

\* For Cement Purchases, competitive bids not taken

For full details see last page of Analysis of Cement Purchases in Year 1921"

## ANALYSIS OF CEMENT PURCHASES IN YEAR 1921—Continued.

Contract Number	Date of award	Quantity bid on	Delivery Points	1	2	3	4	5	6	7	8	9	Quantities delivered	Mill base	Cost at Mill base
C-325	Oct. 18-21	10555	La Habra				2.43	2.47	2.33*	2.62			9200	1.90	17490.00
C-328	Nov. 16-21	2800	Seegeria		3.79	3.79*	2.35*	2.40*	2.30*		2.70*	3.79	1355	2.45	3322.20
C-330	Nov. 16-21	18400	Keystone	3.55	2.79*	3.45*	2.79					3.55	10253	2.41	24773.83
C-332	Nov. 28-21	1200	Sacramento										1540	2.45	3773.00
C-333	Nov. 7-21	150													
C-335	Dec. 1-21	2160	Clements	3.07	3.07	3.07	3.50	3.50*	3.50	2.40*	3.67	3.07*	160	2.35	377.60
C-337	Dec. 14-21	2160	Santa Maria		3.09*	3.09							900	2.398	2138.20
C-340	Jan. 2-21	3550	Permont										3250	2.50	852.50
D-350	Jan. 2-21	1370	Furlock	3.24*	3.24*	3.25		2.34*		3.12	2.74*	3.24	1937	2.69	4026.93
D-353	Mar. 12-21														
D-355	Apr. 28-21	997	Bedding	3.65	3.65	3.55*							997	2.40	2392.80
D-359	Apr. 28-21	1650	Williams		3.77	3.77*							1625	2.40	4380.00
D-363	June 28-21	1850	Red Bluff	3.27	3.27*	3.74	2.14*	2.40*	3.65	3.77	3.72	3.42	2550	2.27	5745.00
D-365	May 1-21	2590	Santa Maria	3.34	3.79*	3.79							2550	2.54	6357.78
D-368	June 22-21	1858	Nevada City	3.54	3.79*	3.79							1855	2.45	4382.40
D-375	Aug. 10-21	750	Santa Maria		2.92	2.92*	2.40*	2.35*		2.55*	2.93*		750	2.25	1677.50
D-376	Aug. 27-21	2707	Marfield			2.94							2707	2.54	6075.78
D-384	Sept. 15-21	700	Yolo		2.45**	3.78							313	2.45	765.65
D-388	Nov. 14-21	7360	Jamestown	3.78	3.78	3.78							4175	2.40	10022.40
D-392	Oct. 4-21	623	Alturas		2.45**								623	2.45	1525.35
D-395	Oct. 8-21	635	San Jose		2.45**								635	2.45	1530.75
D-401	Dec. 1-21	700	Wilgen Hill		2.94	2.84							700	2.40	1140.00
D-404	Nov. 14-21	14500	Westmoreland	2.81	2.94	2.84	2.35	3.69	3.69	3.69	3.69*	3.07	17100	2.29	39159.00
D-405	Apr. 21-21	300	Healdsburg	3.11	3.11*	3.11							300	2.35	705.00
D-407	Nov. 15-21	2154	Merced		3.07	3.07*	2.45*	2.34*	3.35	3.07	2.94	3.07	2327	2.41	5658.07
D-410	Dec. 3-21	4385	Strader		2.90*	3.32*	3.41	2.55*	3.35				4565	2.45	1134.25
D-412	Feb. 7-21	175	Merced		3.32*	3.32*	3.24	2.55*	2.55*				175	2.70	472.50
D-413	Feb. 7-21	530	Bakersfield		3.65	3.65	3.24	2.55*	2.55*	3.77			530	2.80	1754.00
D-414	Feb. 7-21	530	Bakersfield				3.35*	2.55*	2.55*				530	2.50	625.00
D-415	Jan. 15-21	170	Fresno					2.35**					170	2.50	425.00
D-416	Mar. 15-21	300	Lennox										300	2.35	705.00
D-417	Jan. 14-21	627	Williams		2.70**		3.21	2.35*	3.45	3.22	3.17		627	2.70	1692.90
D-418	Jan. 14-21	1997	Lennox										1950	2.70	5292.50
D-419	Jan. 14-21	200	Bakersfield		2.70**		3.11	2.35*		3.77	3.04*		190	2.70	513.00
D-420	Mar. 15-21	281	Merced		2.70**								251	2.70	677.70
D-421	Mar. 18-21	281	Merced												
D-422	May 25-21	275	Castaic				2.25*	2.55*	3.35	2.55*	2.81*	2.25	275	2.25	618.75
D-423	May 25-21	500	Sawyers				2.63	2.55*	3.10	3.57	3.12	2.25	500	1.97	985.00
D-424	May 18-21	1200	Strader				2.59*	2.35*	3.22				1500	2.35	3855.00
D-425	May 18-21	275	Bakersfield				2.94	2.55*					275	2.50	617.50
D-426	May 10-21														
D-427	Mar. 30-21	230	Fresno				3.16*						230	2.30	557.00
D-428	Mar. 30-21	230	Bakersfield										230	2.10	507.00
D-429	June 22-21	200	Oceanside										200	2.150	500.00
D-430	June 22-21	200	Sacramento										225	2.55	573.75
D-431	June 22-21	220	Merced										230	2.25	519.60

\* Successful Bidder

\*\* Competitive Bids  
Emergency Purchase: competitive bids not taken  
For May to bidders see last page of "Analysis of Cement Purchases in Year 1921"



## ANALYSIS OF CEMENT PURCHASES IN YEAR 1921—Concluded.

Contract Number	Date of Award	Quantity bid on	Delivery Points	1	2	3	4	5	6	7	8	9	Quantities Delivered	Mill Base	Cost at Mill
MFO-1559	May 25-21	25500	Tesada		2.70**		2.00**	2.55*	2.35*		2.35*		23470	2.00	42940.00
MFO-1579	Apr. 8-21	160	Alto		3.58*								160	2.70	432.00
MFO-1581	May 1-21	1875	Hosco		3.62**								1174	2.52	2939.48
MFO-1582	July 15-21	200	Ceres		3.08*		2.36*						200	2.51	502.00
MFO-1583	May 23-21	3930	Cath		3.22	3.22	2.92**					3.23	3930	2.50	9776.00
MFO-1584	June 14-21	410	Oceanside		3.27	3.27	3.15*	2.50**	3.10	2.55*	3.12	3.27	2936	2.50	7676.00
MFO-1585	July 1-21	280	Colma		2.55**			2.50*	3.33	2.55*	3.11*		280	2.55	1035.00
MFO-1586	June 22-21	500	Castaic		2.55**								200	2.15	436.00
MFO-1587	Aug. 12-21	350	Dixon		2.55**								350	2.55	892.50
MFO-1588	Sept. 15-21	200	Nordalia		2.45**								200	2.45	392.00
MFO-1589	Sept. 15-21	700	Renton		2.45**								473	2.45	1156.86
MFO-1590	Sept. 22-21	75	San Juan										75	2.45	182.75
MFO-1591	Aug. 10-21	200	Landerholm				2.40*	2.35*			2.93*		200	2.35	450.00
MFO-1592	Aug. 12-21	5790	Ferry	2.94	3.08*	2.94							5134	2.94*	19091.70
MFO-1593	Aug. 12-21	2150	Watson		2.55**	3.17*							2150	2.55	637.50
MFO-1594	Aug. 12-21	2800	Strader				2.40**	2.40*	3.35	2.40*			2800	2.45	687.50
MFO-1595	Aug. 12-21	400	Carl				2.40**	2.35*	2.47	2.33*			400	2.40	960.00
MFO-1596	Aug. 12-21	3000	H. Baetchemur		2.73*	2.73*							3700	2.40	860.00
MFO-1597	Aug. 12-21	750	Tracy		2.93	2.93							10190	2.40	24312.00
MFO-1598	Aug. 12-21	1615	Central		2.93	2.93							1615	2.40	392.00
MFO-1599	Aug. 12-21	2100	Ceres		2.93	2.93							2100	2.40	4085.00
MFO-1600	Aug. 12-21	350	Dixon		2.73*	2.73*							3700	2.40	860.00
MFO-1601	Aug. 12-21	350	Dixon		2.73*	2.73*							789	2.30	1814.70
MFO-1602	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1603	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1604	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1605	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1606	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1607	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1608	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1609	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1610	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1611	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1612	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1613	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1614	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1615	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1616	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1617	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1618	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1619	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1620	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1621	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1622	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1623	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1624	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1625	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1626	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1627	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1628	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1629	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1630	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1631	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1632	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1633	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1634	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1635	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1636	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1637	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1638	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1639	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1640	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1641	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1642	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1643	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1644	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1645	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1646	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1647	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1648	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1649	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1650	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1651	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1652	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1653	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1654	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1655	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1656	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1657	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1658	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1659	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1660	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1661	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1662	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1663	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1664	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1665	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1666	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1667	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1668	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1669	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1670	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1671	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1672	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1673	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1674	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1675	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1676	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1677	Aug. 12-21	165	Fairfield		2.45**	2.45**							732	2.49	1822.68
MFO-1678	Aug. 12-														

## ANALYSIS OF CEMENT PURCHASES IN YEAR 1922.

Contract Number	Date of Award	Quantity	Delivery Points	1	2	3	4	5	6	7	8	9	Completed	Will	Cost at Will
C-339	Jun. 29-22	29,600	Santa Monica	3.58	3.50*	3.50*	2.98	2.97*	2.99	2.60*	2.97	3.58	645	2.38	1,555.10
C-340	Jun. 29-22	7,500	Alamo	3.30	3.42	3.30	3.59	2.45*	3.63	3.69	3.63	3.30	720	2.36	1,522.40
C-341	Jun. 9-22	3,200	San Jose	3.30	3.30	3.30	2.40*	3.43*	3.43	3.60*	3.60*	3.30	3,560	2.40	1,894.40
C-343	Jun. 9-22	1,200	Anderson	2.83*	2.84	2.84	2.94	2.95*	2.95*	2.95*	2.95*	2.95*	675	2.36	1,586.25
C-350	Jun. 29-22	3,900	Colma	3.45	3.89*	3.45	2.95*	2.95*	3.61	2.97	3.61	3.44	1,000	2.44	2,440.00
C-352	Jun. 29-22	1,104	Santa Maria	3.45	3.84	3.45	2.95*	2.95*	3.61	2.97	3.61	3.44	850	2.44	2,346.50
C-353	Jun. 29-22	2,280	San Jose	2.78	2.79	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2,280	2.36	1,684.80
C-355	Jun. 29-22	2,280	Alamo	2.78	2.79	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2,280	2.36	1,684.80
C-357	Jun. 29-22	320	San Lucas	3.07	3.07	3.07	3.07	2.95*	2.99	2.40*	2.40*	2.38*	1,000	2.34	2,340.00
C-359	May 17-22	27,800	Alamo	2.78	2.79	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2,280	2.36	1,684.80
C-360	May 17-22	13,132	San Jose	3.35	3.35	3.35	3.35	3.35	2.40*	2.40*	2.40*	2.38*	2,280	2.36	1,684.80
C-361	May 18-22	580	Alamo	2.78	2.79	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2,280	2.36	1,684.80
C-362	Jun. 9-22	14,240	Santa Monica	2.74	2.74	2.74	2.74	2.35*	2.60*	2.40*	2.40*	2.38*	35	2.35	3,128.14
C-363	May 31-22	1,312	San Jose	3.49	2.35**	2.35**	2.35**	2.35**	2.60*	2.40*	2.40*	2.38*	350	2.35	1,874.50
C-364	May 31-22	280	San Jose	3.49	2.35**	2.35**	2.35**	2.35**	2.60*	2.40*	2.40*	2.38*	350	2.35	1,874.50
C-365	May 31-22	91,25	San Jose	3.49	2.35**	2.35**	2.35**	2.35**	2.60*	2.40*	2.40*	2.38*	9975	2.35	2,444.25
C-404	Jun. 17-22	91,25	San Jose	3.49	2.35**	2.35**	2.35**	2.35**	2.60*	2.40*	2.40*	2.38*	9975	2.35	2,444.25
C-411	Jun. 17-22	590	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-412	Jun. 17-22	3,000	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-413	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-414	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-415	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-416	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-417	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-418	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-419	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-420	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-421	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-422	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-423	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-424	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-425	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-426	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-427	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-428	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-429	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-430	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-431	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-432	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-433	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-434	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-435	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-436	Jun. 17-22	1,500	San Jose	2.52	2.52	2.52	2.52	2.35*	3.35	2.40*	2.40*	2.38*	325	2.40	780.00
C-437	Jun. 29-22	780	Western	3.33	3.33*	3.33*	3.52	2.97	2.97	2.40*	2.40*	2.35*	480	2.35	1,593.00
C-438	Jun. 29-22	800	Livermore	2.74	2.74	2.74	2.74	2.35*	2.97	2.35*	2.35*	2.35*	480	2.35	1,593.00
C-439	Jun. 29-22	1,320	Merced	2.97	2.97	2.97	2.97	2.35*	2.97	2.35*	2.35*	2.35*	480	2.35	1,593.00
C-440	Apr. 28-22	1,950	Strider	2.97	2.97	2.97	2.97	2.35*	2.97	2.35*	2.35*	2.35*	480	2.35	1,593.00
C-441	Apr. 28-22	1,950	Strider	2.97	2.97	2.97	2.97	2.35*	2.97	2.35*	2.35*	2.35*	480	2.35	1,593.00
C-442	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-443	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-444	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-445	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-446	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-447	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-448	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-449	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-450	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-451	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-452	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-453	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-454	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-455	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-456	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-457	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-458	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-459	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-460	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-461	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-462	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-463	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-464	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-465	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-466	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-467	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-468	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-469	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-470	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-471	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.95
C-472	May 11-22	797	Pajaro	2.84	2.85**	2.85**	2.85**	2.35**	2.35**	2.35**	2.35**	2.35**	797	2.35	1,872.9

- \* Successful Bidder
- \* Mill Base Price
- \* Emergency Purchase: competitive bids not taken
- \* For key to bidders see last page of "Analysis of Cement Purchases in Year 1921"

APPENDIX N.

APPORTIONMENT OF RECEIPTS OF STATE  
MOTOR VEHICLE DEPARTMENT.

- (a) Period August 1, 1920-January 31, 1921. Inclusive.
- (b) Period February 1, 1921-July 31, 1921. Inclusive.
- (c) Period August 1, 1921-January 31, 1922. Inclusive.
- (d) Period February 1, 1922-July 31, 1922. Inclusive.





STATE MOTOR VEHICLE DEPARTMENT OF CALIFORNIA.

SEE ANNUAL STATEMENT OF APPROPRIATIONS OF REVENUES PER PERIOD FEB. 1, 1922 TO JULY 31, 1921, 1921.

APPROPRIATIONS	MOTORVEHICLES	APPROPRIATIONS	TRAFFIC	REVENUES	TOTAL	REVENUES	NET TOTAL	PERCENTAGE	NET MOTORVEHICLE	COUNTY'S SHARE	TO COUNTY ENGINE	TO COUNTY ENGINE	TO COUNTY ENGINE
Alameda	373,562.20	3,008.75	176.40	716.50	418,823.15	574.05	417,441.45	19,281.17	397,160.28	198,745.25	20	198,745.25	198,745.25
Alpine	1,000.00	1,000.00	83.00	83.00	2,000.00	83.00	1,917.00	2,000.00	1,917.00	1,917.00	20	1,917.00	1,917.00
Butte	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Calaveras	250.00	250.00	25.00	25.00	500.00	25.00	475.00	500.00	475.00	475.00	20	475.00	475.00
Colusa	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Contra Costa	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
El Dorado	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Franklin	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Glenn	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Humboldt	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Imperial	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Inyo	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Kern	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Los Angeles	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Maricopa	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Mendocino	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Monterey	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Napa	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Orange	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Pasadena	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Petaluma	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Piedmont	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
San Bernardino	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
San Diego	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
San Francisco	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
San Jose	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
San Luis Obispo	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Santa Barbara	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Santa Clara	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Santa Cruz	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Shasta	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Siskiyou	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Sonoma	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Stanislaus	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Stearns	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Sutter	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Tehama	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Tulare	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Trinity	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Yuba	500.00	500.00	50.00	50.00	1,000.00	50.00	950.00	1,000.00	950.00	950.00	20	950.00	950.00
Total	5,413,869.02	53,180.65	5,750.00	10,951.25	6,134,741.97	7,896.30	6,126,845.67	593,062.43	5,533,783.24	2,916,896.62	-	2,916,896.62	2,916,896.62

## DEPARTMENT OF PUBLIC WORKS.

## STATE MOTOR VEHICLE DEPARTMENT OF CALIFORNIA.

EMI ANNUAL STATEMENT OF A PORTIONMENT OF RECEIPTS FOR THE PERIOD AUG 1, 1921 TO JAN 31, 1922, incl.

[illegible]

STATE MOTOR VEHICLE DEPARTMENT OF CALIFORNIA.

SEMI ANNUAL STATEMENT OF APPROPRIATIONS OF RECEIPTS FOR THE PERIOD FEB. 1, 1922 TO JULY 31, 1922, Inc.

	AUTOMOBILES	MOTORCYCLES	AUTO TRUCKS	TRUCKS	TRAILERS	MISCELLANEOUS	TOTAL	REPAIRS	NET TOTAL	EXPENSES FOR FUEL	NET AMOUNT PAID FOR FUEL	MISCELLANEOUS RECEIPTS FOR FUEL	TOTAL FOR FUEL	ONE-HALF COUNTY COUNTS	ONE-HALF COUNTY COUNTS
Alameda	453,509.70	2,863.30	3,072.50	76.25	44,215.25	276.00	1,132.75	1,132.75	504,018.30	21,604.42	432,413.88	67.16	432,481.04	241,340.42	241,340.42
Albany	8,866.40	85.00	85.00	12.00	1,098.40	138.50	1,236.90	1,236.90	13,255.30	2,784.00	10,471.30	1.00	10,472.30	4,183.66	4,183.66
Alhambra	29,370.75	237.00	533.00	40.00	5,055.40	138.50	5,193.90	5,193.90	15,659.30	2,784.00	12,875.30	8.75	12,884.05	51,580.59	51,580.59
Calaveras	11,912.70	23.00	40.00	2.00	5,962.75	71.00	6,033.75	6,033.75	15,006.50	3,399.03	11,607.47	1.25	11,608.72	6,796.37	6,796.37
Colusa	27,438.40	871.00	665.00	5.00	7,452.10	150.00	7,602.10	7,602.10	22,994.10	3,399.03	19,595.07	10.45	19,605.52	13,298.93	13,298.93
Contra Costa	27,438.40	871.00	665.00	5.00	7,452.10	150.00	7,602.10	7,602.10	22,994.10	3,399.03	19,595.07	10.45	19,605.52	13,298.93	13,298.93
El Norte	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Fresno	22,054.50	1,141.50	2,340.00	34.00	12,859.35	300.50	13,159.85	13,159.85	35,007.00	15,335.49	19,671.51	17.60	19,689.11	31,743.03	31,743.03
Glenn	24,468.90	70.00	301.25	30.00	2,298.50	50.00	2,348.50	2,348.50	27,104.05	1,154.87	25,949.18	3.62	25,952.80	13,021.40	13,021.40
Humboldt	6,925.00	181.00	695.00	6.00	6,081.30	66.75	6,148.05	6,148.05	16,284.45	2,784.00	13,500.45	8.16	13,508.61	29,778.90	29,778.90
Imperial	11,912.70	23.00	40.00	2.00	5,962.75	71.00	6,033.75	6,033.75	15,006.50	3,399.03	11,607.47	1.00	11,608.47	13,298.93	13,298.93
Los Angeles	14,116.25	368.00	1,450.00	15.00	18,698.45	231.50	18,929.95	18,929.95	18,929.95	7,448.77	11,481.18	1.69	11,482.87	68,496.96	68,496.96
Mariposa	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Merced	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Modoc	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Monterey	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Orange	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Petaluma	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Piedmont	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Plumas	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Bernardino	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Diego	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Francisco	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Jose	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Luis Obispo	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
San Mateo	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Santa Barbara	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Santa Clara	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Santa Cruz	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Shasta	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Sierra	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Solano	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Sonoma	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Stanislaus	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Sutter	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Tehama	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Tulare	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Trinity	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Ventura	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
Yuba	3,848.30	18.00	30.00	4.50	4,890.80	61.00	4,951.80	4,951.80	12,852.30	1,535.49	11,316.81	1.00	11,317.81	2,458.18	2,458.18
TOTALS	6,582,459.42	30,234.20	60,875.80	724.25	677,459.47	7,331.00	12,079.25	12,330.66	7,407,882.43	334,580.50	7,073,301.93	397.00	7,073,698.93	3,546,999.46	3,546,999.46



**Statement of Registration by Years, of Motor Vehicles in the State of California.  
From the Records of the Motor Vehicle Department.**

Year	Autos and trucks (including exemptions)			Trailers	Motor- cycles	Non- residents	Dealers
	Total	Yearly increase	Per cent increase over pre- vious year				
Previous to 1907	10,020						
1907	14,051	4,031	40.2				
1908	19,561	5,510	39.2				
1909	28,633	9,072	46.3				
1910	44,122	15,489	54.0				
1911	60,779	16,657	37.7				
1912	91,194	30,415	50.0				
1913	119,746	28,522	31.2				
1914	123,516	3,800	3.17		24,709		
1915	163,795	40,279	32.6		26,401		
1916	235,440	71,645	43.7		30,999		
1917	310,916	75,476	32.0		30,417		
1918	370,800	59,884	19.3	674	25,973		
1919	493,463	112,364	30.3	1,674	28,028		
1920	583,623	100,459	20.8	2,300	20,564	13,000	
1921	691,344	107,721	18.4	3,828	18,582	22,923	
1922	816,426	111,582	16.1	4,570	15,631	23,000	10,445
Average			32.2				

**Distribution for 1922, to November 1.**

Automobiles	765,093
Trucks	37,833
Exemptions	13,500
<b>Total</b>	<b>816,426</b>
Trailers	4,570
Non-residents	23,000
Motorcycles	15,631



## APPENDIX O.

## ANALYSIS OF MAINTENANCE EXPENDITURES.

All costs for repairs of the state highways and of their maintenance are paid out of the Motor Vehicle Fund.

The Vehicle Act passed in 1915 (Chapter 188), amended 1917 (Chapter 218), amended 1919 (Chapter 147), amended 1921 (Chapter 61), superseded the older "Motor Vehicle Act," chapter 326 of the Statutes of 1913. Both the 1913 and the 1915 laws created a "Motor Vehicle Fund," but the distribution of the fund differs in the two acts.

Previous to the passage of the Motor Vehicle Act of 1913, chapter 612, Statutes of 1905, was in force, but it provided merely for the collection of nominal registration fees. No portion of the money collected was available for direct expenditure on the highways; the receipts went into the general fund of the state and none of the money was available to the California Highway Commission.

The Motor Vehicle Act of 1913 provided that the state's portion of the fund should be expended through the Advisory Board of the State Department of Engineering. It was the custom of that board to apportion a part of the fund to be expended by the State Engineer on roads taken over by the legislature and on roads in state parks, and a part to the California Highway Commission for expenditure on roads taken over under the State Highway Act. This practice continued until July 27, 1917, when all roads formerly under the control of the State Engineer were turned over to the California Highway Commission.

The Motor Vehicle Fund now has paid into it all moneys received by the Motor Vehicle Department except the moneys received by it for transfers and for operators' and chauffeurs' licenses. The transfer and operators' license fund, plus so much of the other receipts of the department as are needed, up to a maximum limit of 10 per cent of the receipts of the year, is available for expenditure by the Motor Vehicle Department for carrying out the provisions of the Vehicle Act. One-half of the net balance remaining in the Motor Vehicle Fund is credited to the counties from which the money was received and the other half, "in addition to all sums that have heretofore and that may be appropriated hereafter by the legislature for the same purpose," is available for expenditure under the direction of the California Highway Commission for the maintenance and improvement of the state roads and highways under the jurisdiction of the California Highway Commission and for the maintenance and improvement of roads and highways in state parks.

## STATE MOTOR VEHICLE DEPARTMENT OF CALIFORNIA.

County	County Department of Motor Vehicle Buds - January 1 1914 to July 31, 1922 inclusive.										Total County Department
	1914	1915	1916	1917	1918	1919	1920	1921	1922		
Alameda	40,712.82	66,129.28	67,692.92	65,721.22	97,670.26	130,796.74	169,183.14	264,700.83	241,100.62	1,110,854.51	
Albany	1,757.97	1,757.97	1,757.97	1,757.97	1,757.97	1,757.97	1,757.97	1,757.97	1,757.97	17,579.70	
Alameda	4,764.70	1,157.95	1,567.68	2,011.63	1,910.62	12,653.02	3,485.46	4,154.92	3,485.46	28,470.44	
Calaveras	4,764.70	1,157.95	1,567.68	2,011.63	1,910.62	12,653.02	3,485.46	4,154.92	3,485.46	28,470.44	
Colusa	1,991.04	3,104.46	3,269.84	4,947.84	5,886.87	9,145.22	12,659.26	10,567.76	12,368.95	64,876.31	
Colusa Costa	4,764.70	1,157.95	1,567.68	2,011.63	1,910.62	12,653.02	3,485.46	4,154.92	3,485.46	28,470.44	
El Centro	634.23	1,162.32	1,144.10	1,368.71	2,393.55	2,791.69	1,682.13	4,724.38	2,072.30	12,740.12	
El Centro Fresno	21,486.65	33,333.62	35,881.94	8,542.61	63,595.67	99,266.59	131,447.14	174,785.25	174,785.25	776,049.59	
Glenn	2,220.24	3,198.18	3,461.73	4,970.85	7,187.64	10,851.41	14,426.07	13,311.21	13,941.40	71,107.07	
Humboldt	5,130.26	7,688.79	17,648.13	15,365.15	31,307.46	36,567.40	27,856.36	29,728.49	29,728.49	133,754.46	
Imperial	1,197.01	1,134.65	1,663.17	2,457.13	3,529.64	4,741.57	1,126.80	6,077.62	6,077.62	31,560.86	
Los Angeles	11,970.11	17,956.32	22,765.63	31,762.94	35,269.44	46,551.15	57,043.34	74,493.90	88,495.58	385,983.43	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
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Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
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Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85	12,707.35	17,622.83	24,449.25	22,948.66	25,794.25	120,454.43	
Los Angeles	24,456.69	31,267.12	31,766.46	39,864.19	43,569.10	55,917.19	79,253.75	113,811.22	120,454.43	510,763.69	
Los Angeles	3,997.24	6,041.91	6,028.76	10,187.85							



Plate LXXXVII. State Highway, Mendocino County, steam shovel in operation on heavy construction.



Plate LXXXVIII. State Highway, Mendocino County, steam shovel in operation on heavy construction.



The portion of the Motor Vehicle Fund set aside by the State Controller available for expenditure each year, under the direction of the California Highway Commission, follows:

1914*	-----	\$591,228 72
1915*	-----	932,492 79
1916*	-----	964,784 65
1917*	-----	1,247,268 80
1918	-----	1,421,319 79
1919	-----	1,924,299 77
1920	-----	2,434,800 56
1921	-----	3,018,192 36
1922 (first six months)	-----	3,546,979 46
Total	-----	\$16,081,366 90
Expended under direction of State Engineer	-----	541,831 15
Total available for use by California Highway Commission	-----	\$15,539,535 75

\*Includes amounts allotted to State Engineer.

#### EXPENDITURES.

Upon page 147 of this report is given a statement of total expenditures from the California Highway Commission portion of the Motor Vehicle Fund, from the creation of said fund to June 30, 1922. This statement lists the expenditures under nineteen accounts, the total amount expended to June 30, 1922, being \$11,902,862.76.

It should be understood that the several state highway funds provide for the construction of certain specific roads named in the state highway acts, and that the Motor Vehicle Fund also provides for the improvement, in addition to the maintenance, of all roads under the jurisdiction of the California Highway Commission; no matter how such roads came under its jurisdiction. Consequently, there is some overlapping of classes of work done under the various funds, as for instance:

Oiling plants have been constructed under both funds; the land for maintenance yards has been purchased under both funds; construction equipment, engineering equipment, furniture and fixtures, stable equipment, automobile equipment, camp equipment, and shop equipment—all have been purchased under both funds. The equipment, etc., purchased out of state highway fund moneys eventually becomes available for maintenance, but the Motor Vehicle Fund is not charged therewith. Likewise, equipment purchased under the Motor Vehicle Fund is also available for use on work done under the state highway funds.

So the \$11,902,862.76 stated above as the total expenditure to June 30, 1922, from the Motor Vehicle Fund, does not represent all the maintenance expenditures upon the state highways, but it does cover all ordinary maintenance expenditures, together with certain improvement costs.

Account 135, Stores, covers the purchase of materials for future use, and, when actually issued for use on a particular job, the materials are then charged to the job.

Account 145, County Expense, includes the cost of surveys and plans made for the improvement of state roads, which are not included in any of the state highway acts.



All of the expenditures made under accounts 105, 107, 110, 111, 120, 121, 122, 123, 124, 125, 126, 128, 140, 141, 146, and 147, are of such nature that no distribution can be made easily to the various sections. Account 135 represents goods on hand which are further distributed as issued for use. Account 145 is segregated in the detailed accounts by county, route and section and has no practical bearing on the maintenance of highways. For this reason no further analysis of these accounts is made herein. The total expenditures included in these eighteen accounts amount to \$1,020,435.82, or about 8.5 per cent of the total motor vehicle fund expenditures.

#### THE MAINTENANCE TABULATIONS.

Account 103, Highway Maintenance, includes all other expenditures, totaling \$10,882,426.94, and the detailed figures are given on pages 240-250.

This account 103 covers all direct expenditures on the roads for general maintenance, improvement, and reconstruction, including supervision, administration, injuries to employees, repairs to equipment, and other items of a general nature, all of such items as supervision, repairs to equipment, etc., being distributed in proportion to the direct charges on each section.

The highways are listed by counties, the division, route and section being given, as well as a brief description of termini of the various sections, and the expenditures are segregated under three classifications, viz.: "General Maintenance," "Improvement" and "Reconstruction." These three classifications are further broken up into three other subdivisions—"Pavement Base," "Pavement Surface" and "Miscellaneous"—all of which are defined as follows:

"General Maintenance" includes the expenditures to maintain the roads and make minor repairs so as to keep the roads in approximately the same condition as when constructed.

"Improvement" includes expenditures for new construction or betterment, such as changes in line, grade, or type of construction. (See page 239 for further details.)

"Reconstruction" includes expenditures for the rebuilding with original type over large areas, and the rebuilding of an entire unit of construction, even though small. (See page 239 for further details.)

"Pavement Base" includes repairs to concrete, macadam, or other base courses of pavement on top of subgrade.

"Pavement Surface" includes repairs to oil, asphalt, gravel, or other surfaces, and also includes the maintenance of a smooth surface on earth roads. (Repairs to concrete base roads such as the oiling of cracks, etc., have in many cases been charged to "Pavement Surface"—an apparent inconsistency, but, due to the opening of concrete base roads to traffic before the wearing surface was applied, the concrete base became temporarily a pavement surface.)

"Miscellaneous" includes all the other expenditures which are listed on the detailed accounting books as:

"Shoulders" includes all work on earth, oil, macadam, or other shoulders of a temporary or semipermanent nature. (Work on concrete shoulders, which are virtually a widening of the pavement, is not



Plate LXXXIX. State Highway, Los Angeles County, curing concrete base.



Plate XC. State Highway, Los Angeles County, hauling aggregate.

charged to this account, but is charged to "Pavement Base" or "Pavement Surface," as the case may be.)

"Culverts and Drainage" includes all work on drainage ditches, culverts, drains, bridges, trestles, and other drainage structures.

"Guard Rail" includes all work on guard rails, parapet walls, and stone markers.

"Road Sides" includes eradication of noxious weeds, trimming of slopes, elimination of burrowing animals, removal of minor slides and other work of like nature.

"Grading" includes original grading, grade and line changes and restoring the road after slides or washouts, which removed the roadbed.

"Trees" includes the planting, watering and care of trees.

"Signs" includes road signs, highway lighthouses, traffic buttons, and all other signs and signals for the protection of the highway and of traffic thereon.

Under the column headed "Type" appear symbols indicating the character of the construction as of date June 30, 1922, and they have the following significance:

e=earth  
 oe=oiled earth  
 g=gravel  
 og=oiled gravel  
 c=Portland cement concrete  
 oc=oiled concrete  
 om=oiled macadam  
 or=oiled rock  
 b=bridge  
 tc=Topeka surface on concrete  
 te=Topeka surface on earth  
 tm=Topeka surface on macadam  
 p=plank road oiled  
 w=Willite  
 wc=Willite surface on concrete  
 pt=pile trestle  
 bc=Bitucrete surface on concrete  
 ac=asphalt concrete

The column headed "Miles under Maintenance" shows only the mileage of each section which is actually being maintained by the California Highway Commission, the figures being in many cases less than the distance between termini of the sections, due to exceptions not yet taken over, awaiting right of way to be secured by the counties for proposed line changes, awaiting the construction of bridges, overhead or underpass crossings, etc., and roads in incorporated cities.

The "Date Completed" column gives the date the roads were considered to be constructed and turned over to maintenance. In this



column also appear the following symbols where no dates are shown; these symbols have the following significance:

- \* Taken over from the State Engineering Department
- + In progress
- o Established by Statute
- = Taken over from County
- : Special Legislative Act

Some maintenance expenditures have been made on completed portions of roads under contract. The contracts provide for the taking over and maintaining by the state of completed sections not less than one mile in length and a similar policy has been adopted on day labor work, wherever it was necessary to care for traffic during the construction period. Moreover, on some of the mountain roads constructed by day labor, the roadbed is completed and thrown open for traffic and the minor details, such as culvert headwalls and guard rail, constructed at a later date. The expenses of keeping the road in condition for traffic during the interim are proper maintenance charges.

#### IMPROVEMENT.

The expenditures listed under "Improvement" cover, mostly, the surfacing of earth roads with local material; the surfacing of concrete base with thin bituminous carpet or asphaltic concrete mixture; the construction of gravel, oil macadam, and concrete shoulders; the minor improvements such as guard rail, widening cuts, line and grade changes, etc.

All improvements made on roads under the jurisdiction of the California Highway Commission and not named in the state highway acts, have necessarily been made under the Motor Vehicle Fund.

#### RECONSTRUCTION.

Under this heading the larger expenditures are for the reconstruction of oil macadam roads taken over from the counties, and for restoring and strengthening concrete bases which started to fail, due to heavy traffic, changed drainage conditions, poor subgrade, etc. The concrete base reconstruction consists of repairing the original base and adding an additional slab of concrete on top, reinforced in some cases—this work being really an "Improvement" as well as "Reconstruction," although listed under the latter heading.

In a few cases, bridges, constructed by the counties and afterwards taken over by the California Highway Commission, and which had insufficient waterway to carry extreme floods or were destroyed by floods, have been reconstructed under the Motor Vehicle Fund and the expenditures listed under "Reconstruction." The San Luis Rey bridge near Oceanside, in San Diego County, is the largest instance of this class of work.







## MOTOR VEHICLE FUND EXPENDITURES.

Dist.	County	Pte Sec	From	To	Type	Mile Unit	Date Completed	Total	General Maintenance			Improvement			Reconstruction		
									Percent Bond	Paymnt Surf	Mile- Inches	Total	Paymnt Surf	Wheel- Inches	Total	Paymnt Surf	Wheel- Inches
III	Imperial	1	A So-theby Boundary	Garberville	C	10.19	9-29-14	67,670.40		5,972.21	33,442.53	39,414.74		10,866.45	17,389.22	79,284.66	
		1	B Garberville	Garberville	C	15.61	9-29-14	86,715.19	70.21	8,911.64	50,077.93	59,709.76		16,241.56	335.55	16,594.11	4,411.30
		1	C Miranda	Derrville	C	13.77	9-16-15	91,891.86		39,153.53	28,598.71	65,052.24		17,111.69	9,114.93	28,229.62	
		1	D Derrville	Jordan Creek	C	11.19	8-30-15	79,638.30		26,034.47	15,939.94	41,970.41		22,862.07	14,221.59	37,083.65	589.24
		1	E Jordan Creek	Rio Ball	C	2.14	9-11-16	100,076.74	7.48	25,315.32	39,141.76	65,464.56		21,901.60	12,368.43	34,290.03	1,058.79
		1	P Rio Ball	Fortuna	C	4.74	4-5-22	25,840.85		7,121.01	2,631.98	9,952.99		14,815.69	1,658.17	15,897.86	
		1	G Fortuna	Shuba	C	4.32	1-25-17	84,563.33	14,286.92	1,975.38	17,621.44	33,693.74	37,322.41	965.59	12,525.59	5,834.59	
		1	H Shuba	Arctic	C	6.19	6-1-20	77.08		11.14	65.94		77.08				
		1	J Arctic	Trinidad	C	15.6		228.90		728.90			728.90				
		1	K Trinidad	Coyote Hills	C	2.8	6-1-20	15,461.66	900.20	2,882.83	1,584.11	9,856.47		12,800.53	469.58	12,300.63	3,799.33
VI	Inyo	12	A Western Boundary	Shadland	C	6.62	6-1-16	17,094.62	7,484.29	2,148.16	3,092.75	12,799.20					
		12	B Shadland	El Centro	C	12.03	2-20-17	41,902.43	8,960.11	3,401.02	10,297.74	22,638.87		27,692.79		2,071.92	1,632.39
		26	C Kern Springs	Kern Springs	C	6.69	7-16	84,924.01	3,365.82	694.36	1,332.14	5,297.32				4.77	1,630.77
		26	D Tule Wash	Tule Wash	C	11.077	6-18-20	4,264.01	1,603.77	1,330.45	1,271.72	4,264.01	70,154.07	22.49	1,066.26	73,242.82	16,384.17
		26	E Tule Wash	General Wash	C	6.91	6-1-20	2,628.32	1,112.65	109.35	1,365.42	2,628.32					
		26	F El Centro	Northerly Boundary	C	8.33	6-1-21	2,665.56	1,024.85	133.64	1,469.66	2,665.56					
		27	A El Centro	County all	C	1.99		200.01		67.74	162.27	730.01					
		27	B El Centro	County all	C	9.90	6-1-20	1,113.35	11.14	1,097.29	6.92	1,113.35					
		27	C County Wall	Yuma	C	5.92	6-17	122,053.80	334.36	33,944.99	2,951.66	37,229.21	65,354.99	18,469.30		84,824.29	
		27	D Independence	Division Creek	C	10.29	6-20	1,801.89		1,850.66	1.63	1,851.89					
VI	Kern	23	A Independence	Division Creek	C	8.012	4-20	2,394.61	337.48	1,024.71	928.94	2,283.13	92.68				
		23	B Division Creek	El Centro	C	2.448	4-20						1.80				
		23	D 2nd Standard Parallel S.	El Centro	C	11.55		57.46		57.46							
		23	E Bishop	Round Valley Road	C	8.37		57.46		57.46							
		23	F Round Valley Road	Northerly Boundary	C	5.84	4-10-20	6,067.09	129.04	5,239.69	768.15	6,067.08					
		4	A Southern Boundary	Gravine Creek	C	10.739	6-1-21	40,475.80	979.12	8,476.64	39,156.53	47,614.69	7.72	1,899.41	9,816.73	11,210.26	1,071.04
		4	B Gravine Creek	Sec 5 & 6 T 35.5 R 28 E	C	17.291	5-12-16	412,074.79	65,066.45	4,940.95	60,872.13	130,479.17	121,039.05	137,434.55	20,864.49	279,360.29	2,235.34
		4	C Sec 5 & 6 T 35.5 R 28 E	Bishopfield	C	12.265	6-1-15	87,717.22	31,023.07	6,930.98	14,976.29	52,861.34		1,116.98	11.20	1,683.15	34.42
		4	D Bishopfield	Leche	C	0.971											
		4	E Bishopfield	Leche	C	10.175	12-29-14	25,367.56	4,668.53	2,277.69	4,365.10	11,371.62	1,126.22	874.52	6,763.86	8,711.32	798.63
VI	Kane	4	F Leche	Yuma	C	1.011	9-15-20	7,398.46	1,840.26	1,840.26	2,594.63	7,293.46	29.09				
		4	G Yuma	Northerly Boundary	C	9.068	4-30-15	9,304.45	3,124.45	5,100.83	6,594.37	2,950.47					
		10	A Bishop	Barstow Boundary	C	9.027	4-10-16	5,079.03	9,986.62	5,946.04	5,946.04	22,711.96	480.34	18,830.28	2,405.79	2,894.46	4,904.02
		10	B Western Boundary	1 St. R. of Laveau	C	12.401	1-1-21	899.09	296.18	8.05	282.85	538.09					
		16	A Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
VI	Lake	1	A Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	B Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	C Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	D Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	E Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	F Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	G Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	H Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	I Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					
		1	J Western Boundary	Lakeport	C	9.36	10-1-20	28,860.80		1,660.14	13,938.44	16,998.46					

## MOTOR VEHICLE FUND EXPENDITURES.

Div.	County	Rte.	Sec.	From	To	Type	Mileage	Date	General Expenditures				Improvement				Special Section			
									Payment	Receipt	Balance	Total	Payment	Receipt	Balance	Total	Payment	Receipt	Balance	Total
VI	Lassen	28	A	Northerly Boundary	Water	cc	15.6	10-30-30	7,306.65	2,676.65	10,983.30									
		29	B	Compreche	Shawville	cc	15.008	10-30-30	2,705.21	2,705.21	3,350.54									
		29	C	Shawville	Johnstonsville	cc	4.527	1-15-34	1,456.44	87.77	1,544.21									
VII	Los Angeles	2	A	County Highway Rte 3	Sancho El Buena	cc	2.699	9-1-21	5,935.70	5,935.70	17,580.55									
		2	B	Sancho El Buena	Calhoun	cc	6.377	10-30-14	17,939.15	10,792.03	10,225.19	38,765.37								
		2	C	Calhoun	Northerly Boundary	cc	9.984	1-1-15	154,738.16	12,894.89	11,994.22	42,340.31								
VIII	Mariposa	2	A	Los Angeles City limit	Northerly Boundary	cc	1.295	4-1-20	137,765.55	41,567.65	11,460.31	55,280.97								
		2	B	Los Angeles City limit	Castro School	cc	14.126	4-24-18	18,555.88	1,389.81	5,654.80	5,721.69								
		2	C	Sancho El Buena	Calhoun	cc	1.00	6-30	10,097	12,819.19	10,097.80	12,819.19								
IX	San Diego	2	A	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	B	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	C	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
X	San Diego	2	A	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	B	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	C	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
XI	San Diego	2	A	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	B	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	C	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
XII	San Diego	2	A	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	B	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	C	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
XIII	San Diego	2	A	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	B	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								
		2	C	Sancho El Buena	Calhoun	cc	2.715	6-30	10,097	12,819.19	10,097.80	12,819.19								



## MOTOR VEHICLE FUND EXPENDITURES.

Div.	County	Hwy. No.	From	To	Type	Mile's Main Route	Total Completed	General Assistance			Increment			Reconstruction		
								Payment Surface	Local Interest	Total	Payment Surface	Local Interest	Total	Payment Surface	Local Interest	Total
I	Madison	1	Hopland	Utah	R	7.02	11-15-15	47,222.63	496.70	25,105.61	11,790.74	37,391.25	6,894.72	2,404.98	9,299.70	529.68
		1	C	Utah	Payette Creek	cc	4.05	11-15-15	53,742.27	4,905.37	37,854.50	8,732.60	51,402.57	1,450.08	4,209.53	1,458.03
		1	C	Payette Creek	Shawwood	R	7.73	6-23-14	3,745.28	143.71	9,313.34	15,485.22	24,943.27	2,439.47	4,209.53	6,639.99
		1	E	Shawwood	Willits	R	6.93	4-15	18,840.99	22,277.02	41,116.01	22,453.92	20,491.16	27.38	22,574.49	26,954.49
		1	F	Willits	Arden	R	6.03	1-21-14	68,056.60	6,615.94	13,305.29	21,921.23	18,000.99	8,027.31	20,638.52	20,638.52
		1	F	Arden	Long Valley	R	8.32	12-10-18	42,439.70	3,896.30	17,074.07	20,660.37	12,726.43	16,723.48	2,198.47	2,198.47
		1	F	Long Valley	Battlemead Summit	R	10.19	6-20	28,637.68	3,996.30	16,723.61	16,723.61	16,723.61	2,198.47	2,198.47	2,198.47
		1	F	Battlemead Summit	Laguna Valley	R	13.77	6-20	18,921.95	3,779.53	14,924.55	18,704.19	3,119.96	3,119.96	3,119.96	3,119.96
		1	F	Laguna Valley	Bridge Creek	R	17.33	*	21,834.15	1,079.03	8,764.68	9,843.71	1,271.92	1,271.92	1,271.92	1,271.92
		1	F	Bridge Creek	Northerly Boundary	R	6.56	*	11,116.63	2,686.52	19,782.47	22,412.39	8,511.13	9,333.13	8,511.13	8,511.13
VI	Merced	16	Merced	Northerly Boundary	R	9.24	7-20	24,351.07	15,024.50	4,334.15	19,358.65	17,846.55	279.28	6,686.51	22,745.05	4.25
		4	C	Merced	Arden	cc	14.354	8-10-15	23,631.61	17,177.28	4,574.44	9,210.55	30,952.27			
		4	C	Arden	Northerly Boundary	cc	9.629	11-24-14	76,545.01	17,042.66	2,882.58	4,769.63	24,774.87	49,677.36	57,876.74	480.19
		4	D	Merced	Northerly Boundary	cc	9.980	3-25-14	136,618.37	2,882.58	4,769.63	4,769.63	4,769.63	4,769.63	4,769.63	4,769.63
		18	A	Merced	Main Summit	cc	14.910	8-21	2,162.97	874.95	2,841.01	2,841.01	2,841.01	2,841.01	2,841.01	2,841.01
		28	B	Conby	Alturas	R	10.930	*	5,829.04	3,412.97	2,860.53	766.28	2,860.53	766.28	2,860.53	766.28
		28	C	Alturas	Shawd State Line	R	17.111	*	3,412.97	766.28	766.28	766.28	766.28	766.28	766.28	766.28
		28	C	Alturas	Shawd State Line	R	8.00	*	766.28	766.28	766.28	766.28	766.28	766.28	766.28	766.28
		28	C	Alturas	Shawd State Line	R	15.00	*	1,493.48	1,493.48	1,493.48	1,493.48	1,493.48	1,493.48	1,493.48	1,493.48
		28	C	Alturas	Shawd State Line	R	5.763	12-22-17	9,746.50	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15
VI	Mono	23	A	Southerly Boundary	cc	4.776	11-17	3,016.71	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15
		23	B	Sheridan Hill	cc	4.776	11-17	3,016.71	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15	1,562.15
		23	C	Whiskey Canyon	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	D	McGee Creek	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	E	McGee Creek	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	F	Casa Diablo	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	G	Casa Diablo	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	H	Casa Diablo	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	I	Casa Diablo	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
		23	J	Casa Diablo	cc	8.018	*	8,018	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43	2,113.60	461.43
VI	Nevada	40	A	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	B	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	C	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	D	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	E	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	F	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	G	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	H	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	I	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62
		40	J	Payette Creek	cc	11.70	-21	1,771.62	13.60	1,503.87	260.15	1,771.62	260.15	1,771.62	260.15	1,771.62

## MOTOR VEHICLE FUND EXPENDITURES.

Div.	County	Res. Sec.	From	To	Type	Miles Under Maint.	Date Completed	Total	General Maintenance				Improvement				Reconstruction			
									Percent Base	Percent Surface	Mileage	Total	Percent Base	Percent Surface	Mileage	Total	Percent Base	Total		
IV	Napa	8	A	Northerly Boundary	Reps	cc	4-25	11-1-15	29,693.21	10,377.70	9,730.18	7,971.15	27,679.03	23.32	1,181.56	1,174.88				
		8	B	Napa	Easterly Boundary		cc	2-6	11-1-19		9,606.17	9,181.29	6,804.26	25,692.02						
		17	A	Northerly Boundary	Rollinsdale Creek		cc	8-13	12-1-18	708.44	4,431.03	8,177.03	13,316.48	8,391.57						
		17	B	Rollinsdale Creek	Nevada City		cc	8-955		8,391.57	897.31	3,109.65	4,384.61							
II	Nevada	25	A	Nevada City	Northerly Boundary		cc	3-161	12-15-19	8,969.65	4,478.90	4,716.85	6,745.65		36.79	113.42				
		37	A	Northerly Boundary	1 mi. W. of Glace		cc	4-7		2,004.92	1,071.55	1,450.84	3,004.92							
		37	B	3 mi. E. of Glace	S. Mt. Summit Valley		cc	8-10		6,695.28	45.95	2,884.71	6,954.52							
		37	C	Summit	E. Red Banner Lake		cc	3-50		8,735.54	5,753.00	2,882.54	8,735.54							
VI	Orange	37	D	E. Red Banner Lake	Truckee		cc	5-50		3,361.71	1,356.57	2,131.54	3,361.71							
		37	E	Truckee	Sierra County Line		cc	10-20		4,659.09	2,737.41	1,328.58	4,659.09							
		38	A	Northerly Boundary	State St. Truckee		cc	0-8		472.12	72.35	399.77	72.35							
		2	A	Northerly Boundary	Galena		cc	15-11	11-1-15	76,879.25	3,897.22	34,203.83	53,864.88	12.26	1,799.46	6,334.65	14,242.59	14.55	2,754.97	
VII	Placer	2	B	Galena	Irvine		cc	5-682	11-1-15	23,297.52	490.45	4,524.26	8,104.90	13,519.66			4,033.74	56.76	5,689.76	8,666.52
		2	C	Irvine	Santa Anna		cc	3-694	1-1-20	45,759.63	2,346.44	11,777.38	17,425.25	28,450.47	60.43	18,704.34	19,254.41	14.55	14.55	
		2	D	Santa Anna	Ambush		cc	4-897	10-13-14	24,144.69	8.97	3,356.75	4,877.64	476.84	229.12	15,462.39	16,146.35	13.13	13.13	
		2	E	Ambush	Pullerton		cc	4-754	11-1-14	6,897.97		1,364.26	1,957.41	77.55	49.23	3,786.13	3,913.30			
III	Placer	3	A	Northerly Boundary	Northerly Boundary		cc	4-764	3-20-15	162,075.43	317.45	5,129.23	4,361.69	10,763.97						
		3	B	Northerly Boundary	Lieschla		cc	10-17	6-25-14	17,994.26	4,849.30	6,268.69	6,837.07	17,037.26			2,649.38	148,646.56		
		17	A	Lieschla	Northerly Boundary		cc	9-413	12-15-15	28,645.72	2,686.14	1,059.60	5,657.73	8,703.67						
		17	B	Parry	Parry		cc	8-971	6-5-17	7,412.20	1,405.00	919.42	5,987.48	7,412.20						
III	Placer	17	C	Parry	Auburn		cc	6-475	2-5-17	8,641.03	1,075.55	555.84	1,008.54	8,641.03						
		17	D	Auburn	Northerly Boundary		cc	6-697		3,530.57	95.60	2,638.21	795.56	3,530.57						
		37	A	Angels	Angels		cc	7-90		28,294.31	419.22	12,975.98	36,102.69							
		37	B	Angels	Colfax		cc	8-131		12,097.52	9.76	5,943.22	6,534.54	12,097.52						
III	Placer	37	C	Colfax	Gold Run		cc	30-8		15,823.74	12.69	6,955.14	8,865.35	15,814.46						
		37	D	Gold Run	B. B. Crossing E. of Teale		cc	9-6		11,616.03	11.55	5,510.03	6,985.15	11,616.03						
		37	E	B. B. Crossing E. of Teale	Bozelle Gap		cc	6-8		12,300.98	8.18	6,984.49	5,921.31	12,300.98						
		37	F	Bozelle Gap	Northerly Boundary		cc	3-5		5,082.55	4.31	3,644.13	1,964.23	5,082.55						
III	Placer	37	G	1 mi. W. of Glace	3 mi. E. of Glace		cc	3-5		4,481.71	4.22	1,753.57	2,732.12	4,481.71						
		37	H	N. Boundary Summit Valley	Summit Valley		cc	3-0		3,022.09	3.01	972.79	2,545.69	3,022.09						
		38	A	Summit Valley	Truckee River Bridge		cc	8-8		7,852.30	6.20	2,633.75	5,218.55	7,852.30						
		38	C	Truckee River Bridge	Northerly Boundary		cc	5-3		6,975.68		1,767.15	5,199.80	6,966.96						
VII	Placer	38	C	Truckee River Bridge	Northerly Boundary		cc	8-7		5,984.64		2,250.79	3,655.45	5,984.64						
		39	A	Thon Day	Crystal Bay		cc	11-09		33,300.07	42.77	1,942.98	1,415.68	187.10	12,505.31	17,900.83	30,599.24			
		19	A	Northerly Boundary	Revere		cc	9-336	12-22-14	17,394.15	764.33	8,667.17	7,702.65	17,394.15						
		25	A	Northerly Boundary	Beumont		cc	9-999		9,362.57	596.67	2,545.25	4,714.60	7,941.72			5.96	272.35	22.61	90.02
III	Placer	25	B	Beumont	Beumont		cc	3-04		20.95	4.01		16.95	16.95						
		25	C	Beumont	Idaho		cc	0-707	8-1-19	692.38	166.30		178.34	344.72			4.50	4.50		
		25	F	Idaho	N.E. Cor. S. 6 T. 35. 233 E.		cc	8-552	5-1-19	19,600.77	1,345.02	435.22	861.56	2,642.60			8,890.54			
		25	N	N.E. Cor. S. 6 T. 35. 233 E.	Northerly Boundary		cc	14-334	7-2-21	2,443.80	936.59	707.69	818.01	2,443.80						



## MOTOR VEHICLE FUND EXPENDITURES.

Div.	County	Int. Sec.	From	To	Type	Mile Haut. Completed	Date	General Maintenance				Improvement				Reconstruction	
								Pay-ent Base	Total	Pay-ent Surface	Recon- struction	Pay-ent Base	Total	Pay-ent Surface	Recon- struction	Pay-ent Base	Total
III	San Diego	12	B County Boundary	Top of Spring Grade	c	981	2- -21	34.30	34.48			34.48					
	San Diego	12	B County Boundary	Top of Spring Grade	om	4,611	6- -20	31,899.49	18,437.41	4,636.15	18,437.41	29,460.67	600.57			22.90	22.90
	San Diego	4	A Southern Boundary	Manteca	om	2,671	6- -20			6,395.51							
	"	4	B Manteca	Stockton	om	10,495	4-17-20	64,555.66	40,435.33	11,197.37	4,121.42	63,746.12	35.62		1.98	37.60	762.74
	"	4	C Stockton	Houston School	c	46				16,197.30	10,870.92	9,840.95					
	"	4	D Houston School	Northerly Boundary	om	14,611	12- -21	59,476.44	6,632.96	1,665.70	907.67	4,113.14	7.63	1.64	4,656.92	395.79	11,820.35
	"	4	D Houston School	Northerly Boundary	om	3,315	12- -21	6,632.96	1,665.70	907.67	4,113.14	7.63		1.64	4,656.92	395.79	11,820.35
	"	4	D Houston School	Northerly Boundary	om	1,402	6- -20			1,665.70	907.67	4,113.14	7.63			115.04	115.04
	"	5	A Northerly Boundary	Berlin	om	8,077		69,911.77	21,293.40	7,404.32	7,291.46	35,935.08	11,338.21	25,827.19	1,696.94	33,634.33	22.06
	"	5	B Berlin	French Camp	om	9,354	11- -21	70,137.95	17,059.76	7,219.31	21,411.35	46,340.42	1.95	.58	4,182.37	197.18	19,612.63
IV	San Luis Obispo	53	A Northerly Boundary	Thornton	om	4.9		7,143.62	415.79	276.45	6,387.83	7,077.07					
	San Luis Obispo	53	B Thornton	Leoli	om	13.4		1,112.97	76.38	1,033.99	1,112.97	1,700.93					
	San Luis Obispo	66	A Manteca	Mordale School	om	4.		1,972.68	128.25	1,700.93	1,972.68	1,700.93					
	San Luis Obispo	2	A Northerly Boundary	Pase Robles	om	5,039	7- -15	9,933.10	1,986.73	1,036.53	6,912.44	9,932.70		5.40	5.40		
	"	2	B Pase Robles	Atascadero Creek	c	5,609	8-24-15	12,142.69	2,754.71	1,397.46	7,995.32	12,137.49		5.40	5.40		
	"	2	C Atascadero Creek	Santa Margarita	om	8,395	2- 9-15	12,521.35	2,659.95	2,360.81	7,615.60	17,621.36					
	"	2	D Santa Margarita	San Luis Obispo	om	6,392	4- -15	66,625.46	4,776.28	10,556.95	18,345.82	33,574.03	2,095.76	1,157.69	29,768.55	32,659.00	292.40
	"	2	E San Luis Obispo	Arroyo Grande	om	3,629	8- -15										
	"	2	F Arroyo Grande	Southerly Boundary	om	13,612	6-22-15	39,847.51	7,741.08	6,285.73	15,384.54	70,232.35	1,827.04	294.89	6,448.23	9,585.16	
	"	2	P Arroyo Grande	Southerly Boundary	om	642	6-22-15	29,822.93	3,611.32	1,526.30	5,277.16	10,714.78	994.30	9,798.30	8,365.65	19,088.15	
V	San Mateo	33	A Pase Robles	Marilla River	c	8,703	6-13-19	29,822.93	3,611.32	1,526.30	5,277.16	10,714.78	994.30	9,798.30	8,365.65	19,088.15	
	San Mateo	33	C 1 M.L. South of Divide	Northerly Boundary	c	11,865		299.34		184.15	35.16	229.34				40.30	
	San Mateo	2	A Northerly Boundary	Southerly Boundary	om	8,594	12- -19	604.36	95.99	101.30	369.07	561.36				6.06	
	"	2	B San Mateo	Southerly Boundary	om	10,68	4-22-14	7,562.38	15,049.57	25,737.11	48,949.06			450.67	6,440.60	482.16	64,630.92
	"	2	B San Mateo	Southerly Boundary	om	15.40	3-25-14	75,521.30	9,793.48	9,630.87	14,996.08	73,669.43	133.00	31.56	23,941.47	24,166.03	1,210.90
	"	2	B San Mateo	Southerly Boundary	om	4.26	10-30-21										
	"	2	B San Mateo	Southerly Boundary	om	4.26	10-30-21										
	"	2	B San Mateo	Southerly Boundary	om	4.26	10-30-21										
	"	2	B San Mateo	Southerly Boundary	om	4.26	10-30-21										
	"	2	B San Mateo	Southerly Boundary	om	4.26	10-30-21										
VI	Santa Barbara	2	A Northerly Boundary	1 M.L. South of Divide	om	5,807	6-24-15	59,951.14	1,684.14	1,998.32	7,186.44	10,682.50	1,421.57	9,054.33	31,601.42	42,087.42	7,000.82
	"	2	B 1 M.L. South of Divide	Los Alamos	c	3,553	5- -20										
	"	2	C Los Alamos	Zaca	om	11,972	9-25-18	2,665.70	9,394.23	2,665.70	9,394.23	14,946.27	901.99	5.96	4,000.45	4,948.12	
	"	2	D Zaca	Alisal	om	8,753	9-25-18	6,667.31	593.69	4,239.02	6,477.23	8.49			25.73	34.42	
	"	2	E Alisal	Alcatraz School	c	12,074		46,122.11	12,513.73	4,522.71	11,971.66	29,013.40	8,344.07	1,456.21	7,033.47	15,610.45	298.36
	"	2	F Alcatraz School	El Capitlan Creek	c	4,998	5- -16	36,300.83	11,976.65	3,929.60	17,756.30	33,608.46	1,365.46	773.51	13.41	2,692.36	
	"	2	G El Capitlan Creek	El Capitlan Creek	c	2,976	2- -18										
	"	2	H El Capitlan Creek	El Capitlan Creek	c	10,392	3-19-19	37,597.56	9,430.02	942.06	14,993.26	25,930.15	7,136.87	1,710.99	5,701.32	12,638.41	
	"	2	I El Capitlan Creek	El Capitlan Creek	c	9,431	10- -15	57,174.63	6,603.30	979.42	14,087.71	21,970.41	7,930.14			36,554.40	
	"	2	J El Capitlan Creek	El Capitlan Creek	c	9,431	10- -15	57,174.63	6,603.30	979.42	14,087.71	21,970.41	7,930.14			36,554.40	



## MOTOR VEHICLE FUND EXPENDITURES.

Div.	County	Hwy. Sec.	From	To	Type	Miles Paid	Miles Completed	Total	General Expenditure				Improvement				Reconstruction							
									Payment Base	Payment Surface	Rec'd. Interest	Total	Payment Base	Payment Surface	Rec'd. Interest	Total	Payment Base	Payment Surface	Rec'd. Interest	Total				
I	Santa Barbara	2	N	Carpenteria	Southern Boundary	cc	2.954	5-27-14	11,077.05	5,537.54	1,014.01	4,493.23	11,034.76				42.27				42.27			
						cc	2.354	5-27-14																
						cc	9.640	10-15	3,155.74	1,925.29	524.69	684.56	3,155.74											
						cc	6.811	8-7-15	26,931.02	14,097.71	1,465.29	3,077.19	18,550.19	569.73				1,241.10			1,850.83			
						cc	1.019	8-30																
IV	Santa Clara	2	A	Santa Barbara	San Jose	cc	2.655																	
						cc	5.719		144,334.76	19,456.67	2,615.42	6,781.75	283,803.04	1,059.56			8,949.32			104,516.54			10,895.18	
						cc	1.939																	
						cc	5.632	10-6-14	113,310.56	5,921.40	19,184.43	11,432.43	38,768.26	6,150.03			22,472.48			74,703.32				
						cc	1.393	12-7-15																
II	Santa Cruz	42	A	Bergan Hill	Southern Boundary	cc	0.533	11-15-21																
						cc	17.770	11-10-14	258,110.69	14,354.31	33,125.42	10,577.62	58,056.35	49,982.33			20,330.45			1,077.76			4,711.67	
						cc	7.681	1-5-15	22,863.27	13,796.22	13,386.00	9,863.48	37,073.67	66,029.38			13,185.30			1,056.48			11,077.63	
						cc	1.172	7-7-15																
						cc	4.334	7-7-15																
IV	Santa Cruz	5	A	Northern Boundary	San Jose	cc	7.211	10-5-15	33,999.99	5,688.23	22,054.71	6,354.60	35,397.54	7.08			1,565.37			13,182.69			14,765.14	
						cc	1.69	7-25-16	59,654.24	5,093.33	14,853.55	25,769.37	47,862.86	116.83			9,110.18			13,794.68			23,021.86	
						cc	15.38	7-25-16																
						cc	15.97	7-25-15	93,699.77	3,494.56	22,770.82	36,320.94	62,859.92	1,797.13			19,495.69			9,642.03			33,125.85	
						cc	15.07		68,377.13	26.01	9,623.41	16,195.24	55,840.76	6,804.96			2,443.02			4,096.68			86.41	
II	Santa Cruz	44	A	Boulder Creek	California Redwood Park	cc	0.2		9,117.25	9.97	3,321.98	1,796.43	16.59											
						cc	15.764		464.50	6.61	216.17	171.20	783.18						11.72					
						cc	15.076	6-5-15	76,030.41	77.62	33,056.94	19,053.41	33,168.37	23,626.45			415.58			23,842.04				
						cc	29.271	10-5-15	119,871.54	4.30	36,934.28	36,392.43	7,321.17	46,035.35			48,644.37			2,514.01			48,644.37	
						cc	7.211	10-5-15	286,660.60	4.80	36,281.94	56,071.47	9,351.66	143,488.05			46,021.72			190,206.74				
III	Sierra	37	A	Merced County line	State line	cc	6.26	12-30	10,036.90		6,644.04	9,875.12	9,849.16											
						cc	9.769	12-30	12,056.90		5,713.15	11,815.65	34.55						37.41			129.74		
						cc	9.769	12-30	12,056.90		5,713.15	11,815.65	34.55						37.41			129.74		
						cc	14.486		25,620.12		895.68	1,414.04	2,789.72						46.08			23,310.40		
						cc	19.073		2.14															
III	Sierra	37	A	Merced County line	State line	cc	17.069	13-31	11,685.17		2,045.15	7,635.03	9,631.18											
						cc	12.6		11,685.17		8,215.79	3,459.05	11,680.44											
						cc	7.621	12-23-15	36,738.26		5,056.23	9,112.90	14,163.13						24,436.65			24,436.65		
						cc	10.553																	
						cc	10.644		16,979.40															
III	Solano	3	C	Yuba	Cross line	cc	17.400																	
						cc	24.584	12-23-15	96,885.28															
						cc	9.454	7-25-16	6,107.66	1,535.04	435.29	4,130.47	5,697.60											
						cc	9.001	10-5-15	24,439.87	2,769.80	11,433.63	1,897.74	22,143.17											
						cc	.447																	
III	Solano	7	C	Fairfield	Fairfield	cc	6.658	7-7-15	27,769.50	14,279.92	4,005.34	5,993.39	28,239.08											
						cc	8.807	1-11-16	18,447.46	8,820.31	385.45	5,691.70	3,865.45											
						cc	8.301	6-28-18	135,840.79	12,361.4	3,801	2,875.76	11,762.67	98,899.43			17,426.83			1,025.91			2,411.59	
						cc	2.1	1-1-16																
						cc	2.1	1-1-16																
III	Solano	7	C	Fairfield	Fairfield	cc	6.658	7-7-15	27,769.50	14,279.92	4,005.34	5,993.39	28,239.08											
						cc	8.807	1-11-16	18,447.46	8,820.31	385.45	5,691.70	3,865.45											
						cc	8.301	6-28-18	135,840.79	12,361.4	3,801	2,875.76	11,762.67	98,899.43			17,426.83			1,025.91			2,411.59	
						cc	2.1	1-1-16																
						cc	2.1	1-1-16																

## MOTOR VEHICLE FUND EXPENDITURES.

Div	County	Hwy	Sec	From	To	Type	Mile Under	Int. Order	Total	Payment	General Maintenance			Improvement		Reconstruction															
											Payment	Miscellaneous	Total	Payment	Payment	Surface	Miscellaneous	Total	Payment	Payment	Class	Surface	Total								
III	Columbia	8	A	Westerly Boundary	Sta 2 at Cordelia	C	3.656	1-19-19	10,659.14	3,105.60	42.89	7,688.27	20,635.74	23.80	23.80																
	Columbia	8	B	Fairfield	Departure	e	8.89	e	1.00	1.00	1.50	1.50																			
	Columbia	8	B	Dawson	Eliz Telfs	e	11.944	e	1.50	1.50	1.50	1.50																			
	Columbia	8	C	No. line	Westerly Boundary	e	3.30	e	1,282.24	1,282.24	1,282.24	1,282.24																			
IV	Sonoma	1	A	Northerly Boundary	Haulburg	e	4.32	7-25-15	44,298.36	136.66	16,979.23	5,212.63	22,338.92	282.74	11,381.08	10,284.62	21,909.44														
		1	B	Haulburg	Santa Rosa	cc	10.11		60,549.08	30,659.94	12,866.07	11,956.61	55,392.63	957.64	4,194.82	5,152.46	932.76														
		1	C	Santa Rosa	Southern Boundary	e	12.42	11-14-19	67,524.49	25,147.24	3,459.63	29,956.40	59,553.97	307.31	902.42	7,168.43															
		8	A	S.E. County line	Sonoma Creek	cc	6.43	12-2-15	44,319.75	590.90	19,971.15	20,766.29	39,536.64	2,717.00	2,654.09	4,793.09															
III	Humboldt	8	B	Sonoma Creek	Easterly Boundary	e	4.41	*	11,871.33	123.26	9,910.28	2,398.18	8,321.72	93.01	1,051.90	2,184.70	3,549.61														
	Humboldt	8	B	Sonoma Creek	Crests	e	12.056	8-13	228,644.94	9,704.46	6,693.68	8,773.13	23,977.27	122,337.17	136,351.49	17,116.91	274,797.57														
	Humboldt	8	B	Crests	Northerly Boundary	e	7.823	6-23-14	69,077.31	5,853.55	7,446.69	9,725.35	22,029.59	16,140.21	8,690.16	47,047.72															
		13	A	Salida	Cordelia	e	12.732	6-10-16	17,135.63	3,327.77	593.40	4,382.23	8,270.46	6,882.17	6,882.17																
	Sutter	3	A	Yuba City	Westerly Boundary	e	12.952	2-21	2,312.06	668.55	187.66	1,455.67	2,312.06	690.09	690.09																
	Thames	3	B	Fadsworth Canal	Tuba City	e	11.769	1-11-16	11,296.30	2,054.06	397.17	7,696.96	10,608.21																		
	Thames	3	B	Thames Boundary	Los Molinos	e	11.769	10-1-19	2,349.81	690.75	943.02	521.04	2,349.81																		
	Thames	3	B	Thames Junction	Red Bluff	e	10.669	10-10-19	7,346.39	714.43	2,553.36	4,010.01	7,346.39	14,089.62	14,089.62																
	Thames	3	C	Red Bluff	Northerly Boundary	e	13.669	10-1-19	30,636.77	984.72	11,612.86	4,035.37	16,543.15																		
	Thames	3	D	Los Molinos	Red Bluff	e	14.016	11-1-19	409.58	134.53	570.36	1,115.07		710.24	867.97																
II	Trinity	20	C	Westerly Boundary	Thames Junction	e	3.234	12-1-15	17,644.54	2,944.95	4,566.48	8,565.14	16,776.97	40.76	116.97	710.24	867.97														
	Thames	20	D	Burnt Ranch	White Bar Cr.	e	12.934	6-15	20,416.30	2,523.20	17,651.10	20,184.30	234.00	280.00	2,800.92	85.64															
	Thames	20	B	White Bar Cr	Haulburg	e	11.40	11-1-20	11,181.06	8,312.66	5,134.94	8,312.66	17,658.15	27,959.01	85.64																
	Thames	4	A	Westerly Boundary	Quail	e	10.268	3-6-18	11,755.49	5,134.94	8,312.66	4,668.43	11,755.49	6,662.27	794.28																
	Thames	4	B	Quail	Thames City limits	e	12.778	5-28-19	7,446.55	1,931.37	984.06	4,136.64	6,662.27	255.80	794.28																
	Thames	4	C	Thames	Jet West of Vialia	e	9.261	12-10-18	5,839.39	996.26	749.69	3,931.24	5,839.39	255.80	794.28																
	Thames	4	D	Jet West of Vialia	Guthrie	e	3.195	7-25-16	12,177.45	2,427.63	2,170.21	4,299.41	8,953.26	255.80	794.28																
	Thames	10	A	Guthrie	2 mi. South of Guthrie	e	13.98	7-25-16	18,511.85	6,659.76	1,256.42	8,071.24	14,667.42	469.40	3,362.72	13.99	13.99														
III	Thames	10	B	Thames Junction	Vialia	e	3.776	5-12-16	2,852.37	929.14	453.30	893.53	2,852.37	1,879.52	85.64																
	Thames	10	B	Thames Junction	Vialia	e	3.776	5-12-16	2,852.37	929.14	453.30	893.53	2,852.37	1,879.52	85.64																
	Thames	13	B	1 mi. S of Aptos	Seena	e	10.842	6-12-15	7,753.90	4,128.33	87.30	38.25	44.35	9.45																	
	Thames	13	B	1 mi. S of Aptos	Seena	e	11.052	3-11-16	51,753.46	12,971.16	29,904.16	43,153.68	2,384.79	705.56	8,929.54																
	Thames	13	C	Seena	Traylor's Ranch	e	8.6	5-13-16	6,700.43	87.36	4,656.76	1,342.00	6,048.06	2,384.79	705.56	8,929.54															
	Thames	13	D	Traylor's Ranch	Long Barn	e	11.0	*	8,147.53	4,656.76																					



## APPENDIX P.

## WIDENING AND THICKENING OF STATE HIGHWAYS.

WIDENING AND THICKENING WORK COMPLETED OR UNDER CONSTRUCTION, JUNE 30, 1922.

Contract No.	City	County	Res. Sec.	From	To	Estimated Concrete - Mileage - Area	Completed	Type of Work	Total Est. Cost	Cost per Mile	Cost per Mile Surplus
D-344 347 & 348 349 & 350 351 & 352 353 & 354 355 & 356 357 & 358 359 & 360 361 & 362 363 & 364 365 & 366 367 & 368 369 & 370 371 & 372 373 & 374 375 & 376 377 & 378 379 & 380 381 & 382 383 & 384 385 & 386 387 & 388 389 & 390 391 & 392 393 & 394 395 & 396 397 & 398 399 & 400 401 & 402 403 & 404 405 & 406 407 & 408 409 & 410 411 & 412 413 & 414 415 & 416 417 & 418 419 & 420 421 & 422 423 & 424 425 & 426 427 & 428 429 & 430 431 & 432 433 & 434 435 & 436 437 & 438 439 & 440 441 & 442 443 & 444 445 & 446 447 & 448 449 & 450 451 & 452 453 & 454 455 & 456 457 & 458 459 & 460 461 & 462 463 & 464 465 & 466 467 & 468 469 & 470 471 & 472 473 & 474 475 & 476 477 & 478 479 & 480 481 & 482 483 & 484 485 & 486 487 & 488 489 & 490 491 & 492 493 & 494 495 & 496 497 & 498 499 & 500 501 & 502 503 & 504 505 & 506 507 & 508 509 & 510 511 & 512 513 & 514 515 & 516 517 & 518 519 & 520 521 & 522 523 & 524 525 & 526 527 & 528 529 & 530 531 & 532 533 & 534 535 & 536 537 & 538 539 & 540 541 & 542 543 & 544 545 & 546 547 & 548 549 & 550 551 & 552 553 & 554 555 & 556 557 & 558 559 & 560 561 & 562 563 & 564 565 & 566 567 & 568 569 & 570 571 & 572 573 & 574 575 & 576 577 & 578 579 & 580 581 & 582 583 & 584 585 & 586 587 & 588 589 & 590 591 & 592 593 & 594 595 & 596 597 & 598 599 & 600 601 & 602 603 & 604 605 & 606 607 & 608 609 & 610 611 & 612 613 & 614 615 & 616 617 & 618 619 & 620 621 & 622 623 & 624 625 & 626 627 & 628 629 & 630 631 & 632 633 & 634 635 & 636 637 & 638 639 & 640 641 & 642 643 & 644 645 & 646 647 & 648 649 & 650 651 & 652 653 & 654 655 & 656 657 & 658 659 & 660 661 & 662 663 & 664 665 & 666 667 & 668 669 & 670 671 & 672 673 & 674 675 & 676 677 & 678 679 & 680 681 & 682 683 & 684 685 & 686 687 & 688 689 & 690 691 & 692 693 & 694 695 & 696 697 & 698 699 & 700 701 & 702 703 & 704 705 & 706 707 & 708 709 & 710 711 & 712 713 & 714 715 & 716 717 & 718 719 & 720 721 & 722 723 & 724 725 & 726 727 & 728 729 & 730 731 & 732 733 & 734 735 & 736 737 & 738 739 & 740 741 & 742 743 & 744 745 & 746 747 & 748 749 & 750 751 & 752 753 & 754 755 & 756 757 & 758 759 & 760 761 & 762 763 & 764 765 & 766 767 & 768 769 & 770 771 & 772 773 & 774 775 & 776 777 & 778 779 & 780 781 & 782 783 & 784 785 & 786 787 & 788 789 & 790 791 & 792 793 & 794 795 & 796 797 & 798 799 & 800 801 & 802 803 & 804 805 & 806 807 & 808 809 & 810 811 & 812 813 & 814 815 & 816 817 & 818 819 & 820 821 & 822 823 & 824 825 & 826 827 & 828 829 & 830 831 & 832 833 & 834 835 & 836 837 & 838 839 & 840 841 & 842 843 & 844 845 & 846 847 & 848 849 & 850 851 & 852 853 & 854 855 & 856 857 & 858 859 & 860 861 & 862 863 & 864 865 & 866 867 & 868 869 & 870 871 & 872 873 & 874 875 & 876 877 & 878 879 & 880 881 & 882 883 & 884 885 & 886 887 & 888 889 & 890 891 & 892 893 & 894 895 & 896 897 & 898 899 & 900 901 & 902 903 & 904 905 & 906 907 & 908 909 & 910 911 & 912 913 & 914 915 & 916 917 & 918 919 & 920 921 & 922 923 & 924 925 & 926 927 & 928 929 & 930 931 & 932 933 & 934 935 & 936 937 & 938 939 & 940 941 & 942 943 & 944 945 & 946 947 & 948 949 & 950 951 & 952 953 & 954 955 & 956 957 & 958 959 & 960 961 & 962 963 & 964 965 & 966 967 & 968 969 & 970 971 & 972 973 & 974 975 & 976 977 & 978 979 & 980 981 & 982 983 & 984 985 & 986 987 & 988 989 & 990 991 & 992 993 & 994 995 & 996 997 & 998 999 & 1000	III III										











COMPLETED CONTRACTS, JUNE 30, 1922:

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COMPLETED CONTRACTS, JUNE 30, 1922.

[illegible]

COMPLETED CONTRACTS, JUNE 30, 1922.

L.O.	Div.	Sta.	Sec.	Year	To	Length (ft.)	Contract	Contractor	Res Engineer	Type of Work	Materials	Final Estimate	Per-Cont.	Total
41	Montevideo	135	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
42	"	136	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
43	"	137	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
44	"	138	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
45	"	139	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
46	"	140	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
47	"	141	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
48	"	142	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
49	"	143	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
50	"	144	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
51	"	145	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
52	"	146	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
53	"	147	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
54	"	148	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
55	"	149	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
56	"	150	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
57	"	151	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
58	"	152	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
59	"	153	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
60	"	154	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
61	"	155	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
62	"	156	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
63	"	157	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
64	"	158	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
65	"	159	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
66	"	160	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
67	"	161	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
68	"	162	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276
69	"	163	1	1911	Eastern Boundary	4.34	E. C. B. Smith	E. C. B. Smith	A. L. Brown	Gravel	31,014	35,621	3.65	39,276

COMPLETED CONTRACTS, JUNE 30, 1922.

Com. No.	L.O. No.	Dist.	County	Sta. Sec.	From	To	Length (Mile)	Contract	Contractor	Res. Engineer	Type of Work	Wks.	Materials	Total	Part. Comp. Total
P-14	14	San Diego	Sargamito	4	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	W. P. Ireland	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-15	15	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-16	16	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-17	17	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-18	18	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-19	19	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-20	20	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-21	21	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-22	22	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-23	23	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-24	24	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-25	25	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-26	26	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-27	27	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-28	28	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-29	29	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-30	30	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-31	31	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-32	32	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-33	33	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-34	34	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-35	35	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-36	36	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-37	37	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-38	38	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-39	39	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54
P-40	40	"	"	1	Aburn Road	Northerly Boundary	1.85	1-25-12	Burns, Clark & De Rosa	H. H. Burgess	15 ft. Concrete Base	10.80	4.82	15.71	19.54



COMPLETED CONTRACTS, JUNE 30, 1922.

Co. No.	L.O. No.	Div.	County	Sta.	Sec.	From	To	Length (Miles)	Contract	Contractor	Eng. Engineer	Type of Work	Materials	Final Estimate	Perf. Cont.	Total	
P-260	269	111	San Jacinto	111	111	San Antonio	French Camp	3.35	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	34,585	22,774	57,359	1,822	59,181
P-261	270	111	San Jacinto	111	111	San Antonio	Northerly Boundary	10.62	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	55,102	127,724	182,826	6,541	189,367
P-262	271	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-263	272	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-264	273	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-265	274	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-266	275	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-267	276	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-268	277	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-269	278	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-270	279	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-271	280	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-272	281	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-273	282	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-274	283	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-275	284	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-276	285	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-277	286	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-278	287	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-279	288	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-280	289	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-281	290	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-282	291	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-283	292	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-284	293	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-285	294	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-286	295	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-287	296	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-288	297	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-289	298	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-290	299	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-291	300	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-292	301	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-293	302	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-294	303	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-295	304	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-296	305	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-297	306	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-298	307	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-299	308	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-300	309	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-301	310	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-302	311	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-303	312	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-304	313	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-305	314	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-306	315	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-307	316	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-308	317	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-309	318	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-310	319	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-311	320	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-312	321	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-313	322	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-314	323	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-315	324	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-316	325	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-317	326	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-318	327	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-319	328	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-320	329	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-321	330	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-322	331	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-323	332	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-324	333	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-325	334	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-326	335	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-327	336	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-328	337	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-329	338	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19	Day Labor	C. C. Hewitt	15 ft. Concrete Base	44,969	117,907	162,876	5,919	168,795
P-330	339	111	San Jacinto	111	111	San Antonio	San Antonio	10.45	7-12-19</								



COMPLETED CONTRACTS, JUNE 30, 1922.

[illegible]

## COMPLETED CONTRACTS, JUNE 30, 1922.

[illegible]

## COMPLETED CONTRACTS, JUNE 30, 1922:

[illegible]



## INCOMPLETE CONTRACTS, JUNE 30, 1922.

[illegible]



## INCOMPLETE CONTRACTS, JUNE 30, 1922.

Owner.	L.O. No.	Dist.	County	Re.	Sec.	From	To	Length (Mile)	Contract	Date	Contractor	Super.	Type of Work	Value	Exp. to Jan. 30, 1922	Total
286	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
287	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
288	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
289	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
290	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
291	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
292	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
293	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
294	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
295	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
296	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
297	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
298	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
299	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000
300	30-360	VI	Woods	1	A-3	Southerly Boundary	Grass Valley	14.00	1-21	1-21	Heavy-Tibbitts Const. Co.	J. H. Fisher	15 ft. E. of McClellan	10,000	10,000	10,000

## INCOMPLETE CONTRACTS, JUNE 30, 1922.

Coast	L.O.	No.	Dist.	County	Sta.	Sec.	From	To	Length (Miles)	Contract Date	Contractor	Res. Engineer	Type of Work	Work Materials	Total	Notes
P-317	134	204	11	Strom-Maria	See Contract 317-P-48m-204-4	4-3	See Contract 317-P-48m-204-4	See Contract 317-P-48m-204-4	9.20	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	39,000	5,971	59,400
P-318	134	205	11	Strom-Maria	See Contract 317-P-48m-205-4	4-3	See Contract 317-P-48m-205-4	See Contract 317-P-48m-205-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-319	134	206	11	Strom-Maria	See Contract 317-P-48m-206-4	4-3	See Contract 317-P-48m-206-4	See Contract 317-P-48m-206-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-320	134	207	11	Strom-Maria	See Contract 317-P-48m-207-4	4-3	See Contract 317-P-48m-207-4	See Contract 317-P-48m-207-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-321	134	208	11	Strom-Maria	See Contract 317-P-48m-208-4	4-3	See Contract 317-P-48m-208-4	See Contract 317-P-48m-208-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-322	134	209	11	Strom-Maria	See Contract 317-P-48m-209-4	4-3	See Contract 317-P-48m-209-4	See Contract 317-P-48m-209-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-323	134	210	11	Strom-Maria	See Contract 317-P-48m-210-4	4-3	See Contract 317-P-48m-210-4	See Contract 317-P-48m-210-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-324	134	211	11	Strom-Maria	See Contract 317-P-48m-211-4	4-3	See Contract 317-P-48m-211-4	See Contract 317-P-48m-211-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-325	134	212	11	Strom-Maria	See Contract 317-P-48m-212-4	4-3	See Contract 317-P-48m-212-4	See Contract 317-P-48m-212-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-326	134	213	11	Strom-Maria	See Contract 317-P-48m-213-4	4-3	See Contract 317-P-48m-213-4	See Contract 317-P-48m-213-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-327	134	214	11	Strom-Maria	See Contract 317-P-48m-214-4	4-3	See Contract 317-P-48m-214-4	See Contract 317-P-48m-214-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-328	134	215	11	Strom-Maria	See Contract 317-P-48m-215-4	4-3	See Contract 317-P-48m-215-4	See Contract 317-P-48m-215-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-329	134	216	11	Strom-Maria	See Contract 317-P-48m-216-4	4-3	See Contract 317-P-48m-216-4	See Contract 317-P-48m-216-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-330	134	217	11	Strom-Maria	See Contract 317-P-48m-217-4	4-3	See Contract 317-P-48m-217-4	See Contract 317-P-48m-217-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-331	134	218	11	Strom-Maria	See Contract 317-P-48m-218-4	4-3	See Contract 317-P-48m-218-4	See Contract 317-P-48m-218-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-332	134	219	11	Strom-Maria	See Contract 317-P-48m-219-4	4-3	See Contract 317-P-48m-219-4	See Contract 317-P-48m-219-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-333	134	220	11	Strom-Maria	See Contract 317-P-48m-220-4	4-3	See Contract 317-P-48m-220-4	See Contract 317-P-48m-220-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-334	134	221	11	Strom-Maria	See Contract 317-P-48m-221-4	4-3	See Contract 317-P-48m-221-4	See Contract 317-P-48m-221-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-335	134	222	11	Strom-Maria	See Contract 317-P-48m-222-4	4-3	See Contract 317-P-48m-222-4	See Contract 317-P-48m-222-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-336	134	223	11	Strom-Maria	See Contract 317-P-48m-223-4	4-3	See Contract 317-P-48m-223-4	See Contract 317-P-48m-223-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-337	134	224	11	Strom-Maria	See Contract 317-P-48m-224-4	4-3	See Contract 317-P-48m-224-4	See Contract 317-P-48m-224-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-338	134	225	11	Strom-Maria	See Contract 317-P-48m-225-4	4-3	See Contract 317-P-48m-225-4	See Contract 317-P-48m-225-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-339	134	226	11	Strom-Maria	See Contract 317-P-48m-226-4	4-3	See Contract 317-P-48m-226-4	See Contract 317-P-48m-226-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-340	134	227	11	Strom-Maria	See Contract 317-P-48m-227-4	4-3	See Contract 317-P-48m-227-4	See Contract 317-P-48m-227-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-341	134	228	11	Strom-Maria	See Contract 317-P-48m-228-4	4-3	See Contract 317-P-48m-228-4	See Contract 317-P-48m-228-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-342	134	229	11	Strom-Maria	See Contract 317-P-48m-229-4	4-3	See Contract 317-P-48m-229-4	See Contract 317-P-48m-229-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-343	134	230	11	Strom-Maria	See Contract 317-P-48m-230-4	4-3	See Contract 317-P-48m-230-4	See Contract 317-P-48m-230-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-344	134	231	11	Strom-Maria	See Contract 317-P-48m-231-4	4-3	See Contract 317-P-48m-231-4	See Contract 317-P-48m-231-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-345	134	232	11	Strom-Maria	See Contract 317-P-48m-232-4	4-3	See Contract 317-P-48m-232-4	See Contract 317-P-48m-232-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-346	134	233	11	Strom-Maria	See Contract 317-P-48m-233-4	4-3	See Contract 317-P-48m-233-4	See Contract 317-P-48m-233-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-347	134	234	11	Strom-Maria	See Contract 317-P-48m-234-4	4-3	See Contract 317-P-48m-234-4	See Contract 317-P-48m-234-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-348	134	235	11	Strom-Maria	See Contract 317-P-48m-235-4	4-3	See Contract 317-P-48m-235-4	See Contract 317-P-48m-235-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-349	134	236	11	Strom-Maria	See Contract 317-P-48m-236-4	4-3	See Contract 317-P-48m-236-4	See Contract 317-P-48m-236-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-350	134	237	11	Strom-Maria	See Contract 317-P-48m-237-4	4-3	See Contract 317-P-48m-237-4	See Contract 317-P-48m-237-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-351	134	238	11	Strom-Maria	See Contract 317-P-48m-238-4	4-3	See Contract 317-P-48m-238-4	See Contract 317-P-48m-238-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-352	134	239	11	Strom-Maria	See Contract 317-P-48m-239-4	4-3	See Contract 317-P-48m-239-4	See Contract 317-P-48m-239-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-353	134	240	11	Strom-Maria	See Contract 317-P-48m-240-4	4-3	See Contract 317-P-48m-240-4	See Contract 317-P-48m-240-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-354	134	241	11	Strom-Maria	See Contract 317-P-48m-241-4	4-3	See Contract 317-P-48m-241-4	See Contract 317-P-48m-241-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-355	134	242	11	Strom-Maria	See Contract 317-P-48m-242-4	4-3	See Contract 317-P-48m-242-4	See Contract 317-P-48m-242-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-356	134	243	11	Strom-Maria	See Contract 317-P-48m-243-4	4-3	See Contract 317-P-48m-243-4	See Contract 317-P-48m-243-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-357	134	244	11	Strom-Maria	See Contract 317-P-48m-244-4	4-3	See Contract 317-P-48m-244-4	See Contract 317-P-48m-244-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-358	134	245	11	Strom-Maria	See Contract 317-P-48m-245-4	4-3	See Contract 317-P-48m-245-4	See Contract 317-P-48m-245-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-359	134	246	11	Strom-Maria	See Contract 317-P-48m-246-4	4-3	See Contract 317-P-48m-246-4	See Contract 317-P-48m-246-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-360	134	247	11	Strom-Maria	See Contract 317-P-48m-247-4	4-3	See Contract 317-P-48m-247-4	See Contract 317-P-48m-247-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-361	134	248	11	Strom-Maria	See Contract 317-P-48m-248-4	4-3	See Contract 317-P-48m-248-4	See Contract 317-P-48m-248-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-362	134	249	11	Strom-Maria	See Contract 317-P-48m-249-4	4-3	See Contract 317-P-48m-249-4	See Contract 317-P-48m-249-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-363	134	250	11	Strom-Maria	See Contract 317-P-48m-250-4	4-3	See Contract 317-P-48m-250-4	See Contract 317-P-48m-250-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-364	134	251	11	Strom-Maria	See Contract 317-P-48m-251-4	4-3	See Contract 317-P-48m-251-4	See Contract 317-P-48m-251-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-365	134	252	11	Strom-Maria	See Contract 317-P-48m-252-4	4-3	See Contract 317-P-48m-252-4	See Contract 317-P-48m-252-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-366	134	253	11	Strom-Maria	See Contract 317-P-48m-253-4	4-3	See Contract 317-P-48m-253-4	See Contract 317-P-48m-253-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-367	134	254	11	Strom-Maria	See Contract 317-P-48m-254-4	4-3	See Contract 317-P-48m-254-4	See Contract 317-P-48m-254-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-368	134	255	11	Strom-Maria	See Contract 317-P-48m-255-4	4-3	See Contract 317-P-48m-255-4	See Contract 317-P-48m-255-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-369	134	256	11	Strom-Maria	See Contract 317-P-48m-256-4	4-3	See Contract 317-P-48m-256-4	See Contract 317-P-48m-256-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-370	134	257	11	Strom-Maria	See Contract 317-P-48m-257-4	4-3	See Contract 317-P-48m-257-4	See Contract 317-P-48m-257-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-371	134	258	11	Strom-Maria	See Contract 317-P-48m-258-4	4-3	See Contract 317-P-48m-258-4	See Contract 317-P-48m-258-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-372	134	259	11	Strom-Maria	See Contract 317-P-48m-259-4	4-3	See Contract 317-P-48m-259-4	See Contract 317-P-48m-259-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-373	134	260	11	Strom-Maria	See Contract 317-P-48m-260-4	4-3	See Contract 317-P-48m-260-4	See Contract 317-P-48m-260-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-374	134	261	11	Strom-Maria	See Contract 317-P-48m-261-4	4-3	See Contract 317-P-48m-261-4	See Contract 317-P-48m-261-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,000
P-375	134	262	11	Strom-Maria	See Contract 317-P-48m-262-4	4-3	See Contract 317-P-48m-262-4	See Contract 317-P-48m-262-4	11.70	9-20-21	Wear-Tribble Const. Co.	E. E. Weaver	Grading & Gravel Surf.	43,000	1,000	63,







PART III  
REPORT

of the

Division of Engineering and Irrigation

a subdivision of the

DEPARTMENT OF PUBLIC WORKS

of the

STATE OF CALIFORNIA

to accompany the

FIRST BIENNIAL REPORT

of that department

---

NOVEMBER 1, 1922

---

W. F. McCLURE, Chief of Division



CALIFORNIA STATE PRINTING OFFICE  
SACRAMENTO, 1923

# STATE OF CALIFORNIA

## DEPARTMENT OF PUBLIC WORKS

### Division of Engineering and Irrigation

---

AUSTIN B. FLETCHER-----Director of Public Works  
W. F. McCLURE-----Chief of Division of Engineering and Irrigation  
PAUL BAILEY-----Deputy Chief of Division of Engineering and Irrigation  
J. J. HALEY-----Assistant to Chief of Division of Engineering and Irrigation  
R. L. JONES-----Office Engineer  
W. S. POST-----Associate Hydraulic Engineer  
FRED C. SCOBAY-----Associate Hydraulic Engineer  
E. C. EATON-----Irrigation Engineer  
E. A. BAILEY-----Flood Control Engineer  
W. W. WOOLDRIDGE-----River Superintendent

## MEMORIAM

PAUL MANINGHAM NORBOE

Chief Assistant State Engineer

Died November 15, 1921

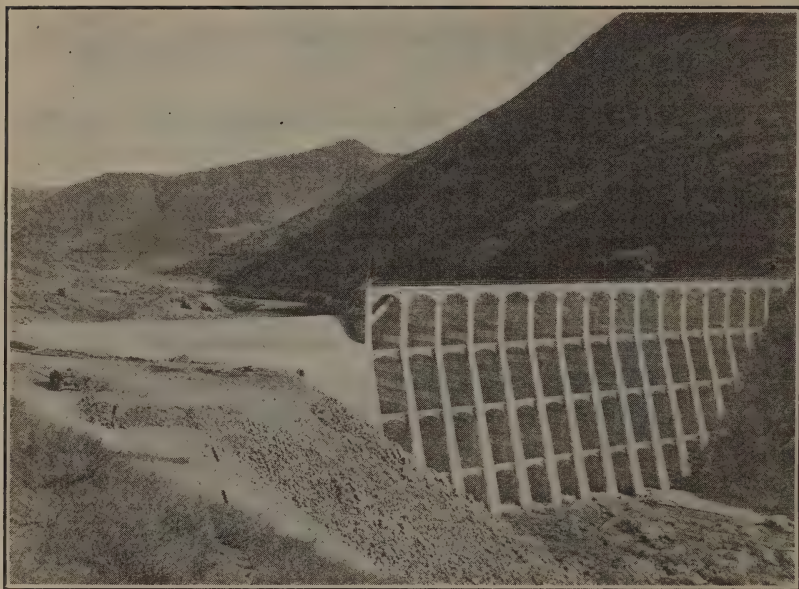
The death of Major Norboe on November 15, 1921, marked the close of a long and honorable career in the Department of Engineering and in the Department of Public Works.

Coming to the Department of Engineering early in 1907 as Assistant State Engineer, Major Norboe was, at the time of his death, the oldest employee in length of service in the department.

From his wide experience as a practicing engineer in various parts of the state, he brought to the department a fund of knowledge only to be acquired by long years of work and study. To his interest as a searcher for truth in his chosen profession, he had, in addition, a keen interest in humanity and in the problems of California.

Born a Californian, he was ever an enthusiastic collector of bits of local history, and it was his favorite diversion to follow in the footsteps of the pioneers.

His loss to California and the Department of Public Works is a great one. To his many friends he will always be remembered for his kindly interest, his ready wit and his loyal and steadfast service.



LAKE HODGES DAM—MULTIPLE ARCH TYPE

The design of dams aggregating a total structural cost of \$7,652,000 were checked and their erection authorized by the Division of Engineering and Irrigation during the past biennium and their construction is under the supervision of the Division.

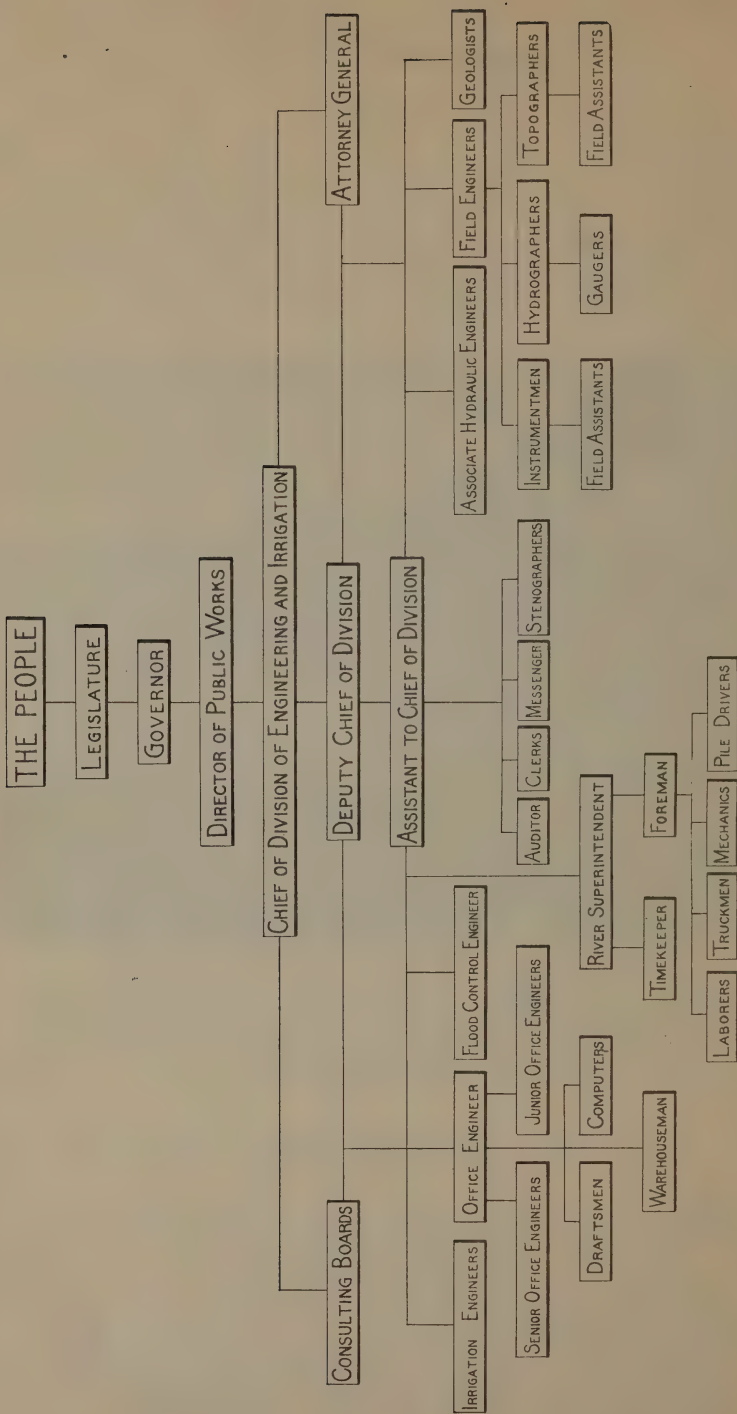


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STATE DEPARTMENT OF PUBLIC WORKS.  
DIVISION OF ENGINEERING AND IRRIGATION.

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ACTIVITIES.

California ranks fifth in value of agricultural crops among the states of a nation that precedes all the countries of the world in value, quantity, and diversity of foodstuffs grown and marketed. Agriculture, so effective in thus placing the United States in the forefront of nations, is second in total income produced by wealth-creating industries in California. Its progression, resulting in attainment to this position among gainful pursuits, is a recent development, being an achievement of the two past decades.

That this could be accomplished was due to the great strides made in production by the California farmer. This came about through the increased productivity of the agricultural lands occasioned by applying irrigation waters to them. Previous to the time when irrigation received its great impulse, agricultural production was limited to the yield of dry farms in the cultivated area. The limit of expansion of dry farmed area was reached about 1885 and since that time increase in production has been brought about by irrigation and the more intensive cultivation of the land.

Making these supplementary waters available to the agriculturist required diversion works, dams, reservoirs, canals, and other retention and conveying works, and these in their entirety are almost always of such a magnitude that they cannot be undertaken by individuals. To be constructed and adequately financed, it has taken associative effort. This collective effort has been made possible by the California Irrigation District Act, passed in 1897 and amended in 1913.

This act provides for the approval of organization and general supervision of construction by the State Engineer or Chief of the Division of Engineering and Irrigation. The financing of these projects has succeeded through bond issues, the favorable market for which has been created and maintained through the state's approval and certification, acting through the State Bond Commission and the State Engineer or Chief of Division of Engineering and Irrigation. Since the enactment of the laws under which the works are planned and constructed and money spent, after review by the California Bond Certification Commission and with the oversight of the State Engineer, the bonds issued have found a ready market, carry a relatively low rate of interest, and not infrequently are disposed of at a premium.

Experience gained prior to 1913 demonstrated that for successful culmination of effort, the formation of these water developing projects required by the agricultural expansion, has needed state sanction; the bonds issued have necessitated certification, and the adequacy of the water supplies to be developed, the safety of the structures erected, the meritoriousness of the entire proposals, have demanded the state's stamp of approval. This is a function of the Division of Engineering and Irrigation, one of the sections of the Department of Public Works.

The agriculturists in the raising, irrigating and marketing the land products are vitally affected by quality and number of roads as the

means of transport and communication; in streams and rivers as sources of water for irrigation and as means of conveyance of the marketable produce; in the apportionment of waters from these streams for use in irrigation; in the construction of dams and reservoirs to conserve, control and develop water supplies; in canals for drainage and water distribution; and in levee construction and river control to prevent inundation. State surveillance of these undertakings, important to California as a whole, as well as to the agriculturist, requires a division of the state activities. To comply with this need, we have the Department of Public Works.

This department has divisions dealing, among others, with highways, engineering and irrigation, water rights and land settlement. In the partition of these functions of the Department of Public Works, some of the most important are assigned to the Division of Engineering and Irrigation. Having to do with the development and control of waters, it contributes directly to agricultural advancement.

In the aggregate it is charged with assenting to needed improvements, with sanctioning proposals that lead to agricultural and industrial betterment, it is obligated to concur with merited and beneficial projects that enhance the general prosperity, and with the development and realization of the full value of the state's advantages; but of all proposals submitted for approval, those without merit, those whose construction spells financial disaster, those whose failure destroys public confidence and casts odium on legitimate enterprises, the onus of rejection lies in this office.

The functions and duties of the Division of Engineering and Irrigation become more voluminous and complex with the development of this state, involving as it does executive and administrative problems, as well as requiring specialized thought and technical experience for the conduct of the engineering and constructive work of the state. During the past generation most all the proposals of irrigation development undertaken by collective effort, have had their adequacy and general merit concurred with, if satisfactory, or rejected, if defective, by this office. During this generation California, though eighteenth in area of land farmed of the states of the Union, has attained to fifth place in value of farm crops.

This office approves millions of dollars worth of improvements every year. It analyzes and passes upon the irrigation, drainage and reclamation of districts that their bonds may be certified and development started or continued. The Division of Engineering and Irrigation is charged with the approval of dams and with the construction of river control works on channels of which the Sacramento River carries the highest valued tonnage of any river in the United States.

It makes hydrographic surveys and cooperates in surveys with the California State Reclamation Board, with the United States Geological Survey in gaging streams and making topographic maps, with the United States Department of Agriculture in needed investigations and with the federal government in maintaining the navigable streams of this state.



These diverse functions of the Division of Engineering and Irrigation, some administrative, some specialized, others executive, but all constructive, contribute to the advancement and well being of the State of California.

#### ORIGIN OF DIVISION.

Prior to August, 1921, the State Engineer was chief executive officer of the Department of Engineering, but with the organization of the State Department of Public Works, in August, 1921, the former Department of Engineering became the Division of Engineering and Irrigation under the Director of Public Works, and the State Engineer became the chief of this division. The new division took over all the functions of the former Department of Engineering, except those pertaining to the office of the State Architect.

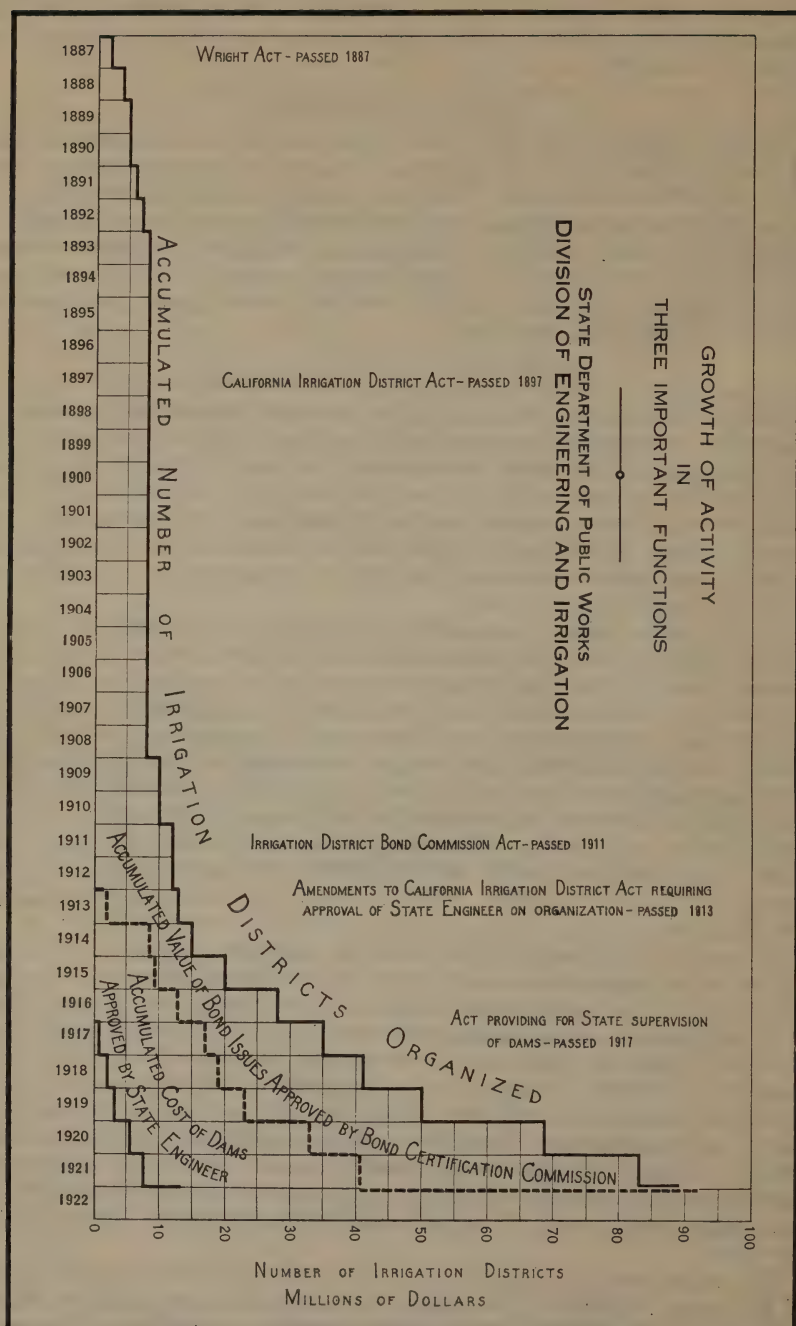
#### GREAT INCREASE IN ACTIVITIES.

The activities of the division office increased manyfold immediately after the reorganization, principally because of the initiation of the investigation of the water resources of the state. This investigation responded to chapter 889 of the 1921 Statutes, which appropriated \$200,000 to prepare a report for the 1923 legislature. To complete the report before this date required the expansion of the organization from 21 employees (excepting laborers on construction) to 109 at the period of maximum pay roll.

At the same time a great increase occurred in the volume of business incident to the permanent statutory functions of the office. During the second year of the biennium about the same number of irrigation districts were reported on for approval of their organization under the Wright Act, but proposed bond issues were investigated for the California Bond Certification Commission amounting to \$56,268,000—fourteen times greater than for the first year of the biennium, and more than half of the total bonds issued by all irrigation districts up to the present day. Applications for the approval of construction plans for dams to a structural value of \$5,632,000 were acted on during the second year of the biennium, which is about three times as great as for the first year.

Of greater significance, however, is the marked increase in activities under the permanent statutory functions of the office during the past two years. The organization of thirty-three irrigation districts has been investigated, or one-third of the total number of irrigation districts in existence at the beginning of the period, and the first district was organized in 1887. Bond issues of irrigation districts have been investigated aggregating \$62,580,150, or one and one-half times the total issues by all irrigation districts up to the beginning of the biennial period. Plans for the construction of dams have been examined, checked and approved, which have a structural value of \$7,652,000, or one and one-half times the value of all plans previously approved by the office.

The accompanying plate portrays the growth of activity under three of the most important permanent statutory functions of the office: reporting on feasibility of irrigation districts, reporting on the pro-



priety of proposed bond issues for irrigation development, and passing on plans for dams and the supervision of their construction. This plate shows by the steep ascendancy of the three lines plotted thereon, how rapidly irrigation districts are organizing and issuing bonds, and the acceleration in dam construction during the last two years.

The division has successfully coped with the problems of rapid expansion of pay roll necessary to accommodate its organization to this increased volume of technical supervision and scientific inquiry, and is now, as the completion is nearing of the special investigation of the water resources of the state, preparing to reduce the pay roll to that commensurate with the still heavy permanent statutory functions of the office. In expanding the organization, particular effort has been put forth to respond to the popular demand for greater efficiency and more economical operation of state offices. The volume of work handled, and particularly the broad scope and speed attained in the completion (16 months) of the water resources investigation of the state is offered as evidence of accomplishment.

#### RECOMMENDATIONS TO LEGISLATURE.

##### Reorganization.

In further response to the behest for practical economy in state affairs, in order that a more thorough and businesslike organization of its activities may be effected, the division urges that certain changes be made in the statutes under which it operates.

At the present time, besides the delegation of duties by special legislative enactments, the division has functions of a permanent character under four separate statutes, the first of which was enacted in 1886 and the last in 1921, and all these functions relate to like activities. These statutes were each prepared to accomplish specific purposes; each separate and distinct. The rush of business of the past biennium afforded the first trial of the combined executive provisions of these statutes. The exigencies of the last two years, with a far greater volume of work in the office than ever before, have indicated certain defects in the provisions of these statutes which are fundamental in character.

As the duties and responsibility of the Division of Engineering and Irrigation increase in coming years, these defects, unless remedied, will stultify the efforts of the division officers to give satisfactory service to the public.

The California Irrigation District Act, under which irrigation districts organize and issue bonds; the Water Storage District Act, under which water storage districts organize; the Bond Certification Commission Act, under which irrigation district bonds are certified to the public as safe investments for trust funds, funds of insurance companies, banks, etc.; and the act of 1917 making it unlawful to construct a dam by other than municipal or public service corporations without first receiving the approval of the State Engineer or Chief of Division on the plans and specifications: all require him to make certain investigation of fact, and then to sit in judgment of his own findings in regard to the organization of districts, approval of bond issues, or plans for dam construction. The Chief of Division and his organization is well



equipped to make these investigations of fact, but to require the same officer to sit in judgment of his own investigations at their completion, and without special provision for public hearings, as all four of these acts neglect,—is both unfair to the state officer and to the public. With the lesser volume of business of the past, and by the use of tact and courtesy, dissatisfaction has been avoided, but with the present increased activities, with less time for personal contact with the public on the part of the Chief of Division, the office should be organized on the same democratic principles which have given satisfaction in the larger governmental departments.

The judicial functions of the office should be grouped in one body, preferably a board of five men, the Chief of the Division the executive officer, but not a member, and to which board the Chief of Division would make reports and recommendations, based on authoritative investigations. This board should hold public meetings at which these reports and recommendations are presented, and at which may be heard such further evidence as the parties interested in the matter may desire to place before them.

Such an organization would afford complete publicity to the decisions of the office, and give full opportunity to all citizens to make such presentations to the board as they may desire. The present statutes have no such provisions, nor is any systematic procedure provided for conducting business. It is only through the personal contact of the officials with the applicants before the office and the confidence inspired thereby that the provisions of the statutes have been in successful operation. The greater volume of business now before the office will, to a large extent, prevent this personal contact in the future.

In making this recommendation to further effect an economical administration, it is not proposed to create a new board, but to enlarge the functions of the present Bond Certification Commission to perform all the judicial or semi-judicial actions now incumbent upon the office of the State Engineer or Chief of Division, and to make the State Engineer or Chief of Division the executive officer of this board. The board would preferably have as members the Attorney General, State Superintendent of Banks, and three other members appointed by the Governor.

With powers and duties so concentrated, the Chief of Division may effectively organize his office, that, distinct from a group of individuals with many dispersed functions, they may be directed in their activities to avoid duplicate and unnecessary work.

An organization so effected would provide proper machinery for the operation of all present state regulatory powers over irrigation development, and such additional powers as future legislation may impose. With these powers centralized in one body, organized on the principles which have given greatest satisfaction to the public in other governmental institutions, a state policy may be initiated in guiding irrigation development which is not now possible, and which is so desirable as development becomes more complex. Perusal of the report on the water resources of the state, which this department will submit to the 1923 session of the legislature, is convincing that the future prosperity of the state is closely coupled with the orderly development of



the state's water resources, and that through a properly conceived state policy, great areas of farm lands may be brought to maximum productivity through irrigation; and that these areas without irrigation, arid of moisture, would remain either wholly unproductive, or nearly so, and contribute but little to the support of the great population which the state's natural advantages are attracting to within its borders.

Just as all judicial functions of the division should be concentrated in this board of five members, similarly all executive functions, some of which are now dispersed in the bond commission and in the executive directors of the Water Storage Act, should be concentrated in the State Engineer or Chief of the Division of Engineering and Irrigation.

#### **Abolishment of Cooperative Investigations with the State Reclamation Board.**

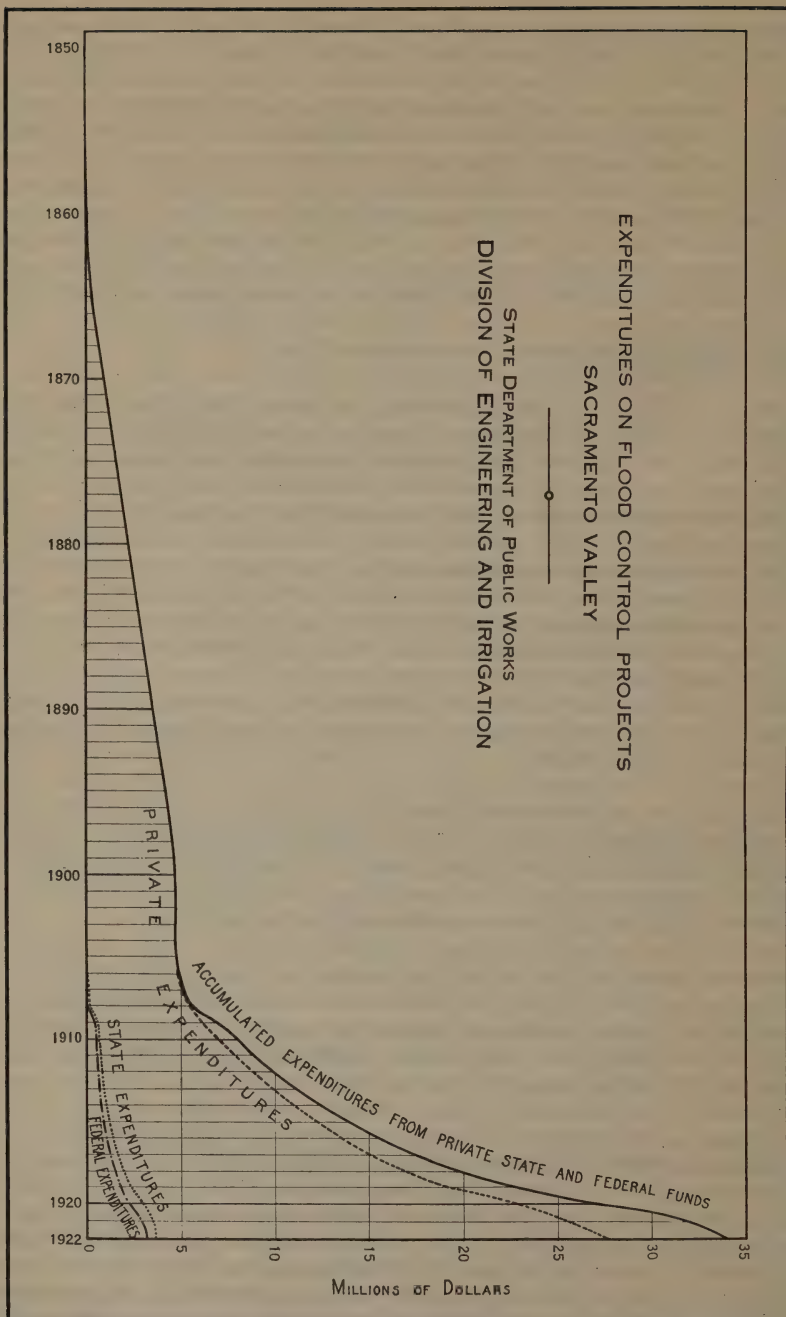
Section 3 of the California Reclamation Board Act, directs the State Engineer or Chief of Division of Engineering and Irrigation, to procure data, make surveys and examinations, to perfect and make additional plans for the reclamation of overflow lands of the Sacramento and San Joaquin rivers and to make reports to the Reclamation Board, and advise and assist them in their work. The same act provides for a separate engineering organization for the board. The board now maintains such a separate organization. These two provisions lead to a duplication of work in the two offices and unnecessary complication to the public in transacting business before the board. As a suggestion for effecting further economy in the executive offices of the state, it is believed that section 3 of the Reclamation Board Act should be repealed, leaving the engineering work of the board to be performed by its own engineering organization.

#### **Bank Protection on Sacramento River.**

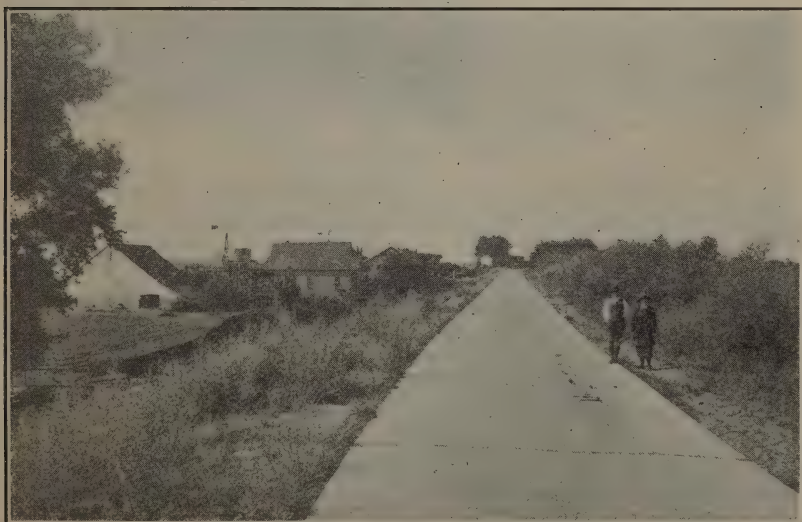
Appropriations for work of the State Engineer have remained stationary while the purchasing power of the dollar has been shrinking. In 1903 the appropriation for rectifying river channels was \$200,000, while in 1921 but \$175,000 was allotted for this activity.

During the intervening years, particularly since 1914, huge sums have been spent in perfecting the works for controlling floods in the Sacramento Valley. The project of the State Reclamation Board in working out a comprehensive scheme of reclamation for the overflow lands of this valley, has been largely completed, and the fertile bottom lands of the valley are now enjoying their first years of freedom from the jeopardy of floods.

Illustration herewith, sets forth, year by year, the expenditures for reclamation works in the Sacramento Valley. The rapid ascendancy of the curved line between the years 1914 and 1922, pictures how at the present time, the low lands of the valley are emerging from a period of construction so greatly exceeding that of any previous period of history, that all previous expenditures appear insignificant. In a manner similar to that here shown for the construction of protective works, the development of the lands themselves has also made rapid strides in the last few years. Many acres of annual cropping have been supplanted by orchards and other permanent crops, particularly in the



fertile soils adjoining the riverbanks. Here also on the higher land of the river banks, amidst trees and gardens, numerous homes have been constructed to replace the cheap dwellings and barns used by the earlier workers of the soil, while living in annual danger of inundation. The danger now removed, beautiful homes, wharves, warehouses, pumping plants, towns and highways appear for miles along the river, where formerly makeshift construction sufficed the gambling farmer to plant and gather the harvest.

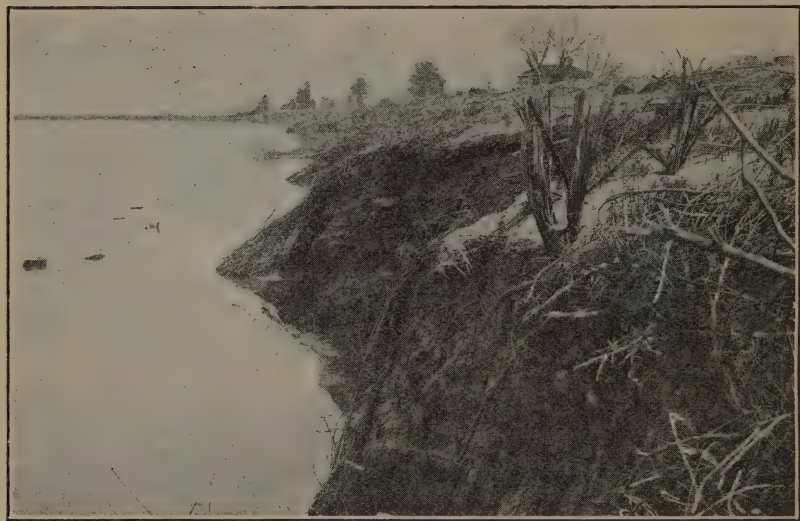


Improvements behind levee on bank of Sacramento River.



Biennial appropriations of the succeeding legislatures since 1897, have fixed the state's responsibility to protect the properties along the river bank through the rectification of the meandering river channel and the protection of the eroding banks. Now that protective works along the river have been completed costing \$34,000,000 and values of improved property have increased seven-fold, it is imperative for the division office to study the problem of confining the river channel to the small area between the levees on either bank of the river. Massive levees 16 to 20 feet in height have no protecting value if the river bank upon which they stand is washed out from under them. One hole in the levees anywhere along their 361 miles of length, and millions of dollars worth of property damage is incurred.

In past years the funds used for river work have largely been spent in constructing brush mattress protection to the banks at points most severely attacked by the current. Other forms of revetment have been



Caving Banks on the Sacramento River.

tried, but all have proved to be so expensive that in the sixteen years from 1907 to 1923 only four miles of bank protection was constructed on the Sacramento River, while the river has 361 miles of bank exposed to the attack of the flowing stream.

To safeguard the immense property values now accumulating behind the river levees of the Sacramento, following the procedure of the past, would require the expenditure of millions of dollars. The available funds of the last two years have been entirely inadequate to even help individual property owners who have applied to the office for state assistance in preventing the destruction of their property. The sums needed for the next five years have been variously estimated by engineers of the division at \$2,500,000 to \$3,000,000. Before suggesting the necessity of spending such a huge sum on construction of revetment works, the expenditure of which would entail large additional costs each year in maintenance of the constructed works, the division has,



during the year just past, given most judicious consideration to discovering a scheme of activity along the river channel, which will effectively control the shifting movements of the river to a permanent channel between the two levees.

It is concluded that a new policy should be adopted in this work; that instead of constructing bank protection works at points of acute danger; instead of battling the attacking current at the last trench where retreat spells large costs in moving levees, roads, houses and other improvements, and where defeat spells destruction; instead of interposing rigid structures to withstand by mass action, the direct onslaught of the ever-encroaching waters: skilled engineering talent should be applied to coerce the current and guide the direction of the eroding waters, restraining the river to its channel and repressing the undermining tendencies of its tortuous course. By coercion and guidance, by making it easier for the waters to continue in their channel than to expend their energies in cutting the confining banks, the vagaries of the river can be controlled and its capricious tendencies suppressed. The direction of the river current at the point of incipient attack on earthen banks can be changed by the cutting of brush, by the planting of willows, and the construction of control works at carefully studied locations in the river's course. By these means it is believed that with an expenditure but little exceeding the cost of maintaining the expensive bank protection works if they were constructed, the river banks may be successfully protected from undue erosion and the river levees may be successfully protected from undermining.

Since it is impossible to ascribe the benefits of expenditures for this class of work to individual properties, for practically the entire valley benefits either directly or indirectly from it, it would seem that its initiation, direction and costs should be undertaken by the state. Request for the appropriation of \$300,000 is therefore made to carry on this work for the next two years.

In addition to the erosion of the banks by the river current, over that portion of the Sacramento and San Joaquin Rivers navigated by steamer traffic, the waves from passing steamers wash down the banks and levee by the persistency of their continued attack. Revetment has been constructed in many locations where, if it were not for the passing steamers, it is probable that no work would have to be done. In the channels downstream from the cities of Sacramento and Stockton, the slope is quite flat and the velocities of flow of the water and likewise its erosive power, are correspondingly less than in the upper reaches of the river. Nevertheless, of the sums spent on bank revetment work since 1907 three-fourths has been spent downstream from these two cities.

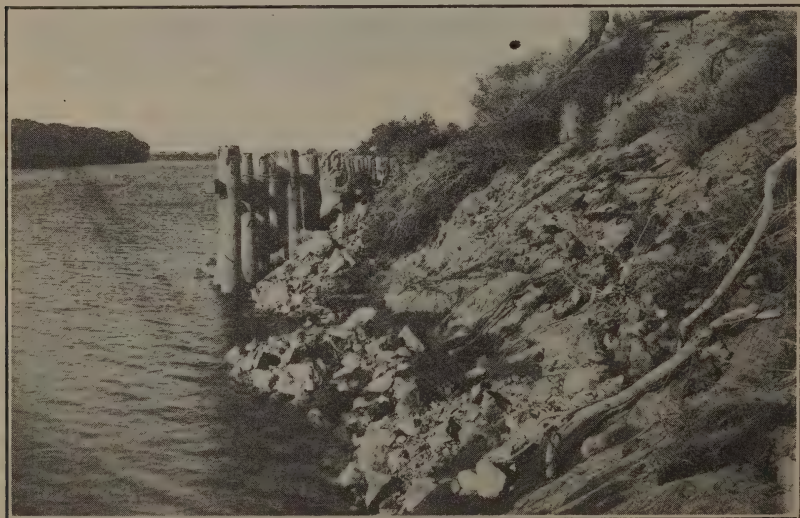
Studies of the division office have revealed that the stratified formation of the banks influence their tendency to cave off, particularly under the attack of steamer waves. In many places the thick and rather hard layers of sediment constituting the river banks are separated with strata of sand, often on planes near the low water line. In such instances it has been observed that the wave action against the sand strata, washes the sand out from between the layers of hard sediment until the overtopping bank caves off in large chunks. The dropping of the large blocks of hard sediment in front of the thinner



Layer of hard sediment breaking off after sand has washed out beneath; on Sacramento River.

layers of sand delays further recession of the banks temporarily, but the chunks of sediment, although hard, seem to break up and be carried away by the current after a time. Broken rock is needed to be dumped in front of these sand strata to prevent further caving of the banks. It is estimated that \$1,000,000 will be required for this purpose during the next five years.

Since the principal danger to the river banks and levees below the cities of Sacramento and Stockton is through the wave action caused by steamer traffic, it would seem proper that the federal government in its jurisdiction over navigation, should appropriate funds for the protecting of this section of the river.



Broken rock protecting caving bank on Sacramento River.



## SUMMARY OF RECOMMENDATIONS TO LEGISLATURE.

### Reorganization.

1. Enlarge functions of the present Bond Certification Commission to include all semi-judicial actions at present incumbent upon the State Engineer or Chief of Division of Engineering and Irrigation and on the executive directors of the Water Storage District Act. Expand Bond Certification Commission to five members, with the Chief of Division of Engineering and Irrigation as executive officer, but not a commissioner. Chief of Division to make reports and recommendations to commission which is to hold public meetings, receive reports and recommendations of executive officer and hear evidence.

2. Repeal all sections of the act that place executive functions of the state's regulatory powers over irrigation developments in the Bond Certification Commission and in the executive directors of the Water Storage District Act, making it the duty of the State Engineer or Chief of Division of Engineering and Irrigation, as executive member of board, to perform these functions.

### Abolishment of Cooperative Investigations with the State Reclamation Board.

Repeal section 3 of the Reclamation Board Act which requires State Engineer to do engineering work for the Reclamation Board, and leave engineering work of State Reclamation Board to be performed by its own engineering organization. Present act leads to duplication of work in the two offices and to unnecessary confusion.

### Bank Protection on Sacramento River.

California has just completed a construction program of flood control works on the Sacramento River that has entailed an expenditure of \$34,000,000. This river now has 360 miles of levees with untold wealth in improvements behind them. The river must be confined to its present channel by construction of control works to prevent the undermining of the levee system completed at so great an expense. For the safety of lives and insurance on the huge sums spent in developing the overflow lands of the Sacramento Valley, \$300,000 is asked for the coming biennium for rectification of river channels.

## ACCOMPLISHMENTS OF BIENNIUM 1921-1923.

### STATE WATER RESOURCES INVESTIGATION.

The first state-wide water resources investigation ever undertaken will be completed within the time limit and within the appropriation. Although delayed in starting, time and money were adequate for giving meticulous care to all aspects of available waters, present uses, costs of control, coordination of the supplies into a comprehensive plan and of the quantities procurable in the ultimate development. Extensive in scope and covering all portions of the state, it comprises data on all sources of water and its useful application and will form a compendium on California's water wealth.

Great interest has been accorded this survey of state waters by the engineering profession who rendered timely assistance, aiding the work by giving data from their office files when this was not otherwise

available to the division. During the conduct of the investigation, volumes of information, hitherto inaccessible, was compiled and graciously offered the division: contributions, gratefully acknowledged, to be absorbed and analyzed; extending the short records or supplying missing measurements; and with the independent investigations of the division, to measurably enhance the value and conduce to the completeness of the report.

Covering, as it does, the greatest area hitherto comprised in any report, this investigation has been continuously prosecuted by this office for sixteen months, has been the largest piece of work by far that has engaged the attention of the division and has occupied the greater part of the pay roll.

Chapter 889 of 1921 Statutes appropriated two hundred thousand dollars (\$200,000), and instructed the State Engineer or Chief of Division, to determine the maximum amount of water which can be delivered to the maximum area of land, the maximum control of flood waters, and the maximum storage of waters, as well as all possible and practical uses of water. The State Engineer was further instructed to prepare a comprehensive plan for the accomplishment of maximum conservation, control, storage, distribution and application of all the waters of the state, together with an estimate of the cost of constructing necessary works, and to submit a report, with recommendations, to the 1923 legislature.

These investigations were initiated in August, 1921, immediately following the organization of the Department of Public Works. Following this date, a consulting board of ten members was appointed by Governor Stephens as provided for in this bill, to advise with the department during the progress of the investigations.

The division prepared a program for the collection of data and preparation of the report, which was approved by the consulting board on October 10, 1921.

The program includes:

1. Collection of all data in public and private engineering offices bearing on this investigation.
2. Analysis of stream flow at the head of the main irrigated areas on every stream.
3. Location of reservoirs on each watershed and securing data on their capacity and construction costs.
4. Classification of storage reservoirs according to cost.
5. Construction of mass diagrams of stream flow for each watershed and determination of increase in water available for irrigation purposes by the construction of reservoirs.
6. Analysis of increase in water available for irrigation purposes by utilization of ground water storage.
7. Determination of areas irrigated in 1920 on each watershed, and also the areas on each watershed which will be benefited by irrigation.
8. Determination of the water requirements of all the agricultural lands of the state.
9. Determination of area that can be irrigated on each watershed by construction of reservoirs in each of the cost classes.



10. Analysis of surplus and deficiency of supply of irrigation water on each watershed with view to developing a comprehensive plan for full utilization of all waters and the irrigation of the maximum possible area including the feasibility of diverting the surplus water from one watershed to another.

11. Estimation of the future water requirements of municipalities and the most favorable sources of supply with view to the maximum utilization of the water resources of the state for both municipal and agricultural purposes.

12. Cost estimates of construction of reservoirs on each watershed, and of conveying water to the head of the irrigable areas in accordance with a comprehensive plan for maximum use of the water.

13. Analysis of the effect of the construction of reservoirs on flood flows.

14. Analysis of power development possible on each stream by the construction of reservoirs, including the feasibility of diverting surplus water from one drainage basin to another, first considering primary use of water for irrigation, and second, the primary use of water for power.

15. Classification of power development by cost per horsepower.

16. Study of means for preventing the encroachment of salt water in river estuaries.

17. Summary of information on effects of deforestation on stream flow.

The division then prepared detail schedules for the accomplishment of this program within the sixteen months then remaining before the convening of the 1923 legislature. The report is being assembled with four appendices in which the data and technical discussions pertaining to it are arranged. These are entitled:

“A” Flow in California Streams.

“B” Irrigation Requirements of California Lands.

“C” Utilization of the Water Resources of California.

“D” Relation of Settlement to Irrigation Development.

The construction of irrigation works alone does not cause intensive agricultural development. Large areas of agricultural land, under irrigation, which do not produce adequate returns on land values and costs of irrigation structures, stand as evidence. For this reason the “Relation of Settlement to Irrigation Development” was added to the program originally laid out. It requires many more people for the intensive farming of irrigated land than for the old methods of dry farming large acreages, and unless these people arrive after the construction of the works, there will be a loss in capital investment in the irrigation works. The Division of Land Settlement and the University of California are cooperating with the Division of Engineering and Irrigation in this phase of the inquiry.

The report is being prepared along comprehensive lines and every possible advantage is being taken of data and information already assembled by others. All the engineering offices of the state, both

public and private, have been approached for engineering measurements and facts pertaining to the study, and volumes of valuable information have been obtained. The scope of the endeavors has been enlarged several-fold because of the data contributed by these offices and a report will be presented much more complete than otherwise would have been possible with the expenditure of \$200,000.

In addition to the advice of the consulting board appointed by the Governor, the division had consultations with engineers eminent in their profession for attainments in the subjects on which their advice was desired. In this manner the entire report is being completed with the approval of the foremost technical experts in all its phases, and no effort has been spared to make this report a most valuable guide to legislation and the future development of the water resources of the state.

### IRRIGATION DISTRICTS.

Since the last biennial report, 23 new districts have been organized under the California Irrigation District Act. Petitions for formation of 35 districts have been filed with various county boards of supervisors.

Under the amendment to the act passed by the 1913 legislature, the State Engineer, or Chief of Division, is required to report on the feasibility of proposed irrigation districts. The law allows 90 days for the investigations of the State Engineer, before the expiration of which time he is required to report to the board of supervisors to whom the petition was presented. On an adverse report, the district may proceed to organize if a further petition signed by three-fourths the property owners of the proposed district is presented to the county board of supervisors. In the event of default by the Chief of Division in reporting to the board of supervisors, the proposed district may also proceed to organize.

Of the 35 petitions to organize irrigation districts since November 1, 1920, the actions are summarized as follows:

Districts organized from approved projects.....	18
Petitions approved, but districts failed of organization at election.....	2
Petitions disapproved—districts not formed.....	3
Districts organized on three-fourths petition.....	5
No report by State Engineer on account of matter before Superior Court of Los Angeles County—petition later withdrawn.....	1
No report by State Engineer—election returns not received.....	1
Petition approved—election returns not received.....	1
Petitions received—investigations pending.....	4

In addition to the above, the proponents of six contemplated districts have been given advice on the procedure for organizing irrigation districts.

Since the last biennial report, the Black Rock Irrigation District has been dissolved and proceedings are now under way for the dissolution of the Kasson, Southern Lassen and Honey Lake Valley Districts.

LIST OF IRRIGATION DISTRICTS AS OF OCTOBER 1, 1922,

Name of district	County	Year organized	Area acres	Bonds voted	Address of secretary
Alpaugh	Tulare	1914	8,861	\$283,000	Alpaugh
Alta	Tulare-Fresno	1888	180,000	543,000	Dinuba
Anderson-Cottonwood	Shasta	1914	32,500	1,255,000	Anderson
Baker	Glenn	1922	1,280		Butte City
Banta-Carbona	San Joaquin	1921	18,000		Tracy
Baxter Creek	Lassen	1917	11,000	511,000	Lassen
Beaumont	Riverside	1919	3,161	230,000	Beaumont
Browns Valley	Yuba	1888	44,328	140,000	Browns Valley <sup>2</sup>
Butte Valley*	Siskiyou	1920	38,600		Macdoel
Byron-Bethany	Contra Costa	1919	17,600	550,000	Byron
Carmichael	Sacramento	1916	3,006	90,000	R.f.d. 3, bx. 259, Sacramento
Citrus Heights	Sacramento	1920	3,028	262,000	Fair Oaks
Compton-Delevan	Colusa	1920	12,661	575,000	Willows
Consolidated	Fresno	1921	150,000	850,000	Selma
Corcoran	Kings	1919	48,438	760,000	Corcoran
Cordua	Yuba	1920	5,422	267,000	Marysville
Crooks Canyon*	Modoc	1919	6,080	80,000	Alturas
El Camino*	Tehama	1921	7,556		Gerber
El Solyo*	Stanislaus	1921	3,783		
Fair Oaks	Sacramento	1917	4,000	200,000	Fair Oaks
Fall River Valley	Shasta	1922	12,820		
Feather River*	Sutter	1920	3,027		Nicolaus
Foothill	Fresno-Tulare	1920	58,000		Orosi
Fresno	Fresno	1920	242,000	2,000,000	Fresno
Glenn-Colusa	Colusa-Glenn	1920	103,000	2,587,000	Willows
Grenada	Siskiyou	1921	5,055	240,000	Grenada
Happy Valley	Shasta	1891	18,210	765,000	Oinda
Honcut-Yuba	Yuba-Butte	1919	31,442		Honcut
Honey Lake Valley*	Lassen	1916	33,150		Amadee
Hot Springs Valley	Modoc	1919	9,610	160,000	Alturas
Imperial	Imperial	1911	603,840	16,000,000	El Centro
Island No. 3	Kings	1921	3,000		Hanford
Jacinto	Glenn	1916	11,300	238,000	Glenn
James	Fresno	1920	26,952	1,000,000	San Joaquin
Kasson	San Joaquin	1921	5,986		Tracy
Klamath-Shasta Valley	Siskiyou	1921	287,000		Montague
Knightsen	Contra Costa	1919	9,961	650,000	Knightsen
Laguna	Fresno	1920	37,000	265,000	Laton
La Mesa, Lemon Grove and Spring Valley	San Diego	1913	14,794	1,232,500	La Mesa
Lemoore	Kings	1920	52,300		Lemoore
Lindsay-Strathmore	Tulare	1915	15,285	1,650,000	Lindsay
Little Rock Creek	Los Angeles	1892	3,672	308,000	Palmdale
Lone Tree	Contra Costa	1920	2,167	160,000	Brentwood
Long Valley Creek*	Lassen	1916	34,000		Doyle
Madera	Madera	1920	353,000	28,000,000	Madera
Maxwell	Colusa	1918	8,832	260,000	Colusa
Medano	Madera-Merced	1921	13,530		Le Grand
Mendota*	Fresno	1921	68,000		Fresno
Merced	Merced	1919	181,920	12,000,000	Merced
Modesto	Stanislaus	1887	81,183	4,226,511	Modesto
Mojave River*	San Bernardino	1917	27,665		Victorville
Naglee-Burk	San Joaquin	1920	3,346	200,000	Tracy
Nevada	Nevada	1921	209,000		Grass Valley
Newport Heights	Orange	1913	1,503	160,000	Costa Mesa
Newport Mesa	Orange	1918	670	50,000	Costa Mesa
Oakdale	Stanislaus-San Joaquin	1909	74,246	2,399,500	Oakdale
Oroville-Wyandotte	Butte	1919	17,700	2,000,000	Oroville
Palmdale	Los Angeles	1916	4,756	445,000	Palmdale
Paradise	Butte	1916	11,200	490,000	Paradise
Plainsburg*	Merced	1919	5,717		Plainsburg
Princeton-Codora-Glenn	Glenn-Colusa	1916	13,861	175,000	Princeton
Provident	Glenn-Colusa	1918	22,861	1,190,000	Willows
Red Rock Creek	Lassen	1918	23,515		Ravendale

\*Formed without State Engineer's approval.

<sup>1</sup>Issued without approval of Bond Commission.

<sup>2</sup>Browns Valley paid off its bonds at 80 cents on the dollar.

LIST OF IRRIGATION DISTRICTS AS OF OCTOBER 1, 1922—Concluded.

Name of district	County	Year organized	Area acres	Bonds voted	Address of secretary
Riverdale*	Fresno	1920	16,000	123,000	Riverdale
San Dieguito	San Diego	1922	3,100		Encinitas
San Ysidro	San Diego	1911	492	25,000	San Ysidro
Scott Valley	Siskiyou	1917	5,131	125,000	Fort Jones
South Capay	Glenn	1921	1,486		Orland
Southern Lassen*	Lassen	1915	21,500		Doyle
South San Joaquin	San Joaquin	1909	71,050	4,335,000	Manteca
Stinson	Fresno	1921	16,020		Helm
Stratford	Kings	1916	9,200		Stratford
Suisun*	Solano	1921	41,075		Suisun
Surprise Valley*	Modoc	1913	17,500		Fort Bidwell
Table Mountain	Butte	1922	3,941		
Terra Bella	Tulare	1915	12,000	1,000,000	Terra Bella
Thermalito	Butte	1922	3,100		
Tracy Clover	San Joaquin	1922	1,107		
Tranquillity	Fresno	1913	11,300	260,000	Tranquillity <sup>1</sup>
Tulare	Tulare	1889	39,760	500,000 <sup>2</sup>	Tulare
Tule	Lassen	1920	25,400	806,000	Susanville
Turlock	Stanislaus-Merced	1887	178,798	6,770,000	Turlock
Victor Valley*	San Bernardino	1917	71,517		Victorville
Walnut	Los Angeles	1893	869		Rivera
Waterford	Stanislaus	1914	13,577	670,000	Waterford
Webster	Madera	1913	15,000		Madera
West Side	San Joaquin	1915	11,828	545,000	Tracy
West Stanislaus*	Stanislaus-Merced	1920	35,681		Crows Landing
Williams*	Colusa	1920	9,021	600,000 <sup>1</sup>	Williams
Total, 89 districts			3,929,893	\$100,566,511 <sup>4</sup>	

\*Formed without State Engineer's approval.

<sup>1</sup>Issued without approval of Bond Commission.

<sup>2</sup>Tulare bought up its bonds at 53 cents and burned them in 1903.

<sup>4</sup>Less \$640,000 Browns Valley and Tulare districts' bonds paid and canceled.



The California Irrigation District Act and the Bond Certification Commission Act provide for the approval and certification of bond issues of irrigation districts by the California Bond Certification Commission, of which the State Engineer, or Chief of Division, is a member. The approval and certification of these bonds make them legal investments for trust funds, funds of insurance companies, savings banks, etc. The engineering investigations upon which the Bond Commission bases its judgment are made by the State Engineer or Chief of Division.

The following table presents a summary of this work for the past two years:

APPLICATIONS FOR STATE APPROVAL OF IRRIGATION DISTRICT BONDS,  
1921-1922,

Name of district	Amount of approved bond issue	Amount of bond issue not approved
Banta-Carbona .....	\$696,000	
Baxter Creek .....	511,000	
Citrus Heights .....	262,000	
Consolidated .....	775,000	
Consolidated .....	75,000	
Cordua .....	75,000	
Crooks Canyon .....		\$180,000
Fresno .....	2,000,000	
Glenn-Colusa .....	2,342,150	
Grenada .....	240,000	
Happy Valley .....	150,000	
Hot Springs Valley .....	60,000	
Imperial .....	7,500,000	
Knightesen .....	650,000	
Laguna .....	265,000	
Little Rock Creek .....	248,000	
Lone Tree .....	160,000	
Madera .....	28,000,000	
Merced .....	12,000,000	
Feather River .....		95,000
Naglee Burke .....	200,000	
Palmdale .....	63,000	
Provident .....	190,000	
Red Rock Creek .....		600,000
Riverdale .....	123,000	
South Capay .....		88,300
Tule .....	806,000	
Honeycut-Yuba .....		1,713,400
Oroville-Wyandotte .....	2,000,000	
Byron-Bethany .....	176,600	
San Dieguito .....	335,700	
Totals .....	\$59,903,450	\$2,676,700

Expenditures from the construction funds of irrigation districts created from the sale of approved and certified bonds, are under the jurisdiction of the Bond Commission and all budgets of expenditures, proposed contracts, etc., relating to these expenditures are examined by the division office for the Commission. Field inspections of construction work and examination of the affairs of the districts are made from time to time.

WATER STORAGE DISTRICTS.

Under the Water Storage Act of 1921, the State Engineer or Chief of Division receives petitions for the formation of water storage districts. Hearings are then conducted and engineering investigations made to determine the practicability, feasibility and utility of the projects. In

conclusion, an order is made of the findings, and if approved the boundaries are fixed, locations for storage specified, cost of project estimated, and an election held on the organization.

In performing these functions, the law provides for two executive directors to assist the State Engineer. Messrs W. P. Boone of Fresno and D. Joseph Coyne of Los Angeles have been appointed by the Governor.

#### **San Joaquin Water Storage District.**

A petition for the organization of a water storage district to include about 550,000 acres of land on the west side of the San Joaquin River, lying under canals mainly in the ownership of Miller & Lux, Inc., was presented to this office in April, 1922, and a hearing held May 26 and 27 at Los Banos. A favorable ruling on the sufficiency of the petition was made at that time. Engineering investigations of the feasibility of the proposed district were undertaken. During July and August negotiations between the Miller & Lux Inc. and the Madera Irrigation District resulted in an agreement under which it was proposed to organize a larger water storage district to include at least part of the lands of the Madera Irrigation District. Investigations concerning the formation of this larger district are now in progress.

#### **Kern River Water Storage District.**

A petition for the organization of a water storage district of about 250,000 acres lying on the delta of the Kern River was presented to this office in May, 1922. At a hearing on June 4 a favorable ruling on the sufficiency of the petition was made. Subsequent hearings have been held at which evidence relating to the feasibility of the project has been presented and petitions for the exclusion of lands presented by individual owners. No ruling on the feasibility of the district has been made. The date of the next hearing is set for December 15, 1922.

#### **Buena Vista Water Storage District.**

A petition for the organization of lands susceptible of irrigation from the lower reaches of the Kern River was presented to this office in August, 1922, and a hearing held on September 8, 1922. This district proposes to cooperate with the Kern River Water Storage District in storage on the Kern River. The boundaries as described in the petition include all lands lying below the present diversion points of the Miller & Lux canals, which are owned by parties to the Miller-Haggin agreement.

### **DAM AND BRIDGE CONSTRUCTION.**

The statutes provide that no dams shall be constructed by others than municipalities or public utility corporations, except that the plans and specifications be first approved by the State Engineer or Chief of Division. It is also required that the construction of these dams be completed to the satisfaction of the State Engineer. During the past two years plans and specifications for the following dams have been

approved by the office and field inspections made of those under construction:

#### APPROVED DESIGNS OF DAMS 1921-1923.

Name of Dam.	County.	Type of Dam.	Height feet.
Pacoima.....	Los Angeles.....	Concrete arch.....	375
Everly.....	Modoc.....	Earth fill.....	10
South Tule.....	Tulare.....	Concrete curved gravity.....	42
Mud Flat.....	Lassen.....	Earth.....	27
Deep Cut.....	Lassen.....	Earth.....	35
Cosumnes.....	Sacramento.....	Concrete—gravity.....	19
Live Oak Canyon.....	Los Angeles.....	Concrete—gravity arched.....	76
San Dimas.....	Los Angeles.....	Concrete—gravity arched.....	125
Hole (reconstruction).....	Riverside.....	Hydraulic fill.....	40
Henshaw.....	San Diego.....	Hydraulic fill.....	120
Dam No. 1, Little Rock Power and Water Co.....	Los Angeles.....	Rock fill.....	107
Exchequer.....	Mariposa.....	Constant angle arch.....	320
Rhinedollar (E'ery).....	Mono.....	Rock fill.....	28
Little Rock Creek.....	Los Angeles.....	Concrete multiple arch.....	158
Mt. Diablo Country Club Reservoir.....	Contra Costa.....	Earth.....	11
Verdugo Road Reservoir.....	Los Angeles.....	Earth, concrete facing.....	--

The law requires that the plans and specifications for bridges over navigable streams be approved by the State Engineer or Chief of Division. None have been presented for approval during the past two years.

#### RECTIFICATION OF RIVER CHANNELS.

##### Construction of Current Retards at Jacinto and Arnold Bends.

A new type of bank revetment was introduced into California with the construction of current retards to protect the caving banks of the Sacramento River at Jacinto and Arnold Bends. This type of protection has been successfully used on the Missouri River to protect dangerously caving banks with a great saving in costs over types previously used there. The retards consist of a windrow of trees built outward from the bank and with their trunks parallel to the bank. The butt ends of these trees are placed upstream and fastened to cables which bind the windrow together and lead upstream to concrete piles jetted down with their tops below the stream bed. These cables hold the windrow in place against the impinging current. Extending out into the stream, these windrows make an effective retard to the current near the bank. Their partial permeability to the flow of the stream tends to relieve the formation of eddies on the downstream side of these retards and make them effective in causing sedimentation. These retards are placed at intervals along the bank to conform to the configuration of the stream channel.

Three retards were constructed during 1922 in the sharp bend of the river near Jacinto. The cost of this construction was shared equally by Reclamation District No. 2047, Levee District No. 1, and the state. Four retards were also constructed during 1922 at Arnold Bend near Colusa. The cost of this work was shared equally by Reclamation District No. 2047 and the state.

##### Clearing Channel of Sacramento River—Colusa to Chico.

The below-normal run-off in the Sacramento River of several of the recent seasons and the great increase in diversions for irrigation during the spring and summer months have made conditions favorable for the



growth of willows in the bottom and sides of the river channel. From Colusa to Chico, a distance of 51 miles, 425 acres of willows were cut during the summer and fall of 1922. These willows were growing rapidly on the leeward side of bends and on new forming bars, to become dense thickets obstructing the flood channel. The deposit of sand and gravel amongst these bushes by the retarding of the flood current in passing over and through them has been building new bars and enlarging old ones, all to cause further attack by the eroding current upon the river banks on the opposite side of the channel to the building bars. Many of the young willows grubbed out in this work were planted again in advantageous locations to protect exposed banks and by their growth and assistance in causing deposition of detritus, to aid in rectifying the river channel. All together about twelve acres of willows were planted.

#### **Reclamation District No. 1500.**

Racetrack and Ministerial bends, about thirty miles upstream from Knights Landing on the Sacramento River, have suffered heavily from the attacks of the river current. Reclamation District No. 1500 has spent large sums in preventing the undermining of their levee in these bends. A project for digging cut-off channels through these bends has been before the State Reclamation Board, but no program for construction has yet been arranged.

To hold the river from breaking through into the highly developed area behind the levee, additional protection had to be placed in these bends. Sixteen hundred feet of brush mattress, sixty feet wide, was placed, together with repairs to old revetment and isolated mats, with a total length of 3000 feet. This work was done in the fall and early winter of 1922. Twenty-three hundred dollars was spent on this work. The state paid one-third and furnished equipment and a superintendent.

#### **Edinger-Johnson Levee.**

The bend in the Sacramento River at the Edinger-Johnson place near Hood has been a point of severe attack by the waves and river current for the past several years.

By December, 1921, the banks had caved in several places, so that the levee was materially weakened. Great property values depend upon the protection of this levee in the reclaimed land back from the river. A break in the levee in a time of flood would not only cause serious damage to these properties, but would impair the navigable channel of the Sacramento River.

The caving of the banks at this point is caused by the waves and current washing away the sand which lays below the thick strata of sediment composing the river bank. As the sand washes out from beneath the sediment, the overlying hard bank caves off in chunks to be later broken up and washed away by the waves and river current. In 1919 bricks were dumped in front of the bank at the points of most serious erosion, but this did not prove sufficient for the protection of the bend. Following December, 1921, 1800 cubic yards of broken rock were spread in front of the bank to prevent the waves and current from further attack on the low-lying sand strata.



#### **Rough and Ready Island.**

Concrete revetment on Rough and Ready Island having a total length of 3000 feet and a width of 14 feet was completed in September, 1921. This revetment protects portions of the levee along the navigable channel leading to Stockton, from the wash of waves occasioned by steamer traffic on this channel. The property owners paid half the cost of this work. The state paid the other half, and furnished equipment and superintendence.

#### **Reclamation District No. 17 on San Joaquin River.**

Work was started in July, 1920, on the front of Reclamation District No. 17 near the mouth of Walthall Slough on the San Joaquin River. The protection was completed in September, 1921. The slopes of the levee were paved with three inches thickness of concrete and a brush mattress thirty feet wide was extended into the river from the toe of the concrete revetment at the low water line. About 900 lineal feet of bank was so protected. The cost was \$16,698.98 and was paid for by the property interests. The state furnished its equipment and superintendence.

#### **Lower Sherman Island.**

Protection work started in July, 1920, to prevent wave action on the lower Sacramento and San Joaquin rivers from washing down the levees on Lower Sherman Island, was completed in the spring of 1921. This work consisted of the brush fence three feet wide and five feet high, held in place with stakes on six foot centers. It was undertaken on the request of the State Board of Control, who had recently purchased the property for a spoil area to the dredging operations now in progress for opening up the mouth of the Sacramento River. These dredging operations are a part of the flood control project of the Sacramento Valley.

#### **Mad River.**

Twelve hundred lineal feet of brush and rock revetment was placed on the bank of Mad River in Humboldt County during July and August, 1920.

### **INTENSIVE ENGINEERING STUDIES.**

#### **Water Resources of Kern River.**

Bulletin No. 9, "Water Resources of Kern River and Adjacent Streams and Their Utilization," of the Department of Engineering, was published after completing a field investigation which beginning in December, 1919, continued through the year 1921. These investigations were undertaken at the request of local interests and consisted principally of the study of surface storage possibilities and of ground water supply and its utilization. Conclusion was reached that a reasonably well-maintained supply was available from both sources to irrigate about 300,000 acres, and recommendations were made for the establishment of boundaries for a water storage district. A complete description of the work and the results is given in the bulletin. The work was per-

formed with Harry Barnes in the field, under the supervision of S. T. Harding. The cost of the work was paid for as follows:

Kern County .....	\$5,000 00
Kern County Land Company.....	5,000 00
Tejon Ranch Company.....	5,000 00
Department of Engineering.....	10,000 00

#### Water Resources of Tulare County.

An investigation of the water resources of Tulare County was commenced in 1920 at the request of Tulare County Water Users' Association. Available data on stream flows, storage sites and underground water was assembled and field work conducted to obtain supplementary data. The principal field work was directed toward the study of ground water conditions. Fluctuations of wells were observed, estimates made of the draft on the ground water and compared to the natural replenishment of these underground basins. Surface storage sites were also investigated and several surveys made.

The results of this work are now being printed in Bulletin No. 4 of the Department of Public Works, entitled "Water Resources of Tulare County and their Utilization," which gives a full account of the work.

The field work for this report was handled by G. H. Russell and Chester Marliave, under the direction of S. T. Harding. The cost of the work was paid as follows:

Tulare County Water Users' Association.....	\$1,500 00
Tulare County .....	5,000 00
Division of Engineering and Irrigation.....	6,600 00

#### Water Resources of San Jacinto Valley—Riverside County.

San Jacinto Valley, lying in the westerly portion of Riverside County, has a watershed area of 330 square miles, and there are 248,000 acres of arable land needing irrigation in the valley. The rainfall is only about thirteen inches in the valley and irrigation is essential for agricultural productivity. The water supply being small compared to the area of land to be irrigated, the controversy between the various parties developing the valley had resulted.

To furnish information for the equitable adjustment of claims between the various parties, the Division of Engineering and Irrigation entered into a contract with five of the organizations in the valley and with the Division of Water Rights, for investigating the water resources of the valley and their utilization. The Division of Engineering and Irrigation subscribed \$1,000 to this work and the use of an automobile and other equipment, while the Division of Water Rights subscribed \$2,000 and the local interests \$5,000. The work is now in progress under the direction of the Division of Water Rights and it is expected to reach completion in the spring of 1923.

#### Water Resources of Mono Basin.

Resulting from much controversy over water rights and rights of way over federal lands in the Mono Lake Drainage Basin, a resolution was passed by the Mono County grand jury in 1921 requesting that an

investigation be made by the Division of Engineering and Irrigation. An engineer was assigned to this work, the history of the acquirement of these rights was reviewed, the plans for additional development examined, and a report is being prepared.

#### COLORADO RIVER COMMISSION.

The Colorado River flows southerly along the entire eastern boundary of Imperial County, California. During the past twenty years a very prosperous community has been developed in the Imperial Valley, Imperial County, under the authorization of our irrigation district laws. The irrigation district contains something over 500,000 acres of very fertile land, and secures its entire water supply from the Colorado River. During the low water flow of the river of three seasons within the past eighteen years, there has been a shortage of water for irrigation. A larger area of land is now being irrigated and a larger amount of water is needed, hence a much more serious condition is anticipated in the future because of the sure occurrence of other seasons of scant supply.

The other extreme as to the amount of water flowing down the Colorado River, namely: that of floods, creates a very serious condition also. The Imperial Valley Irrigation District has been compelled during a number of years past to spend large amounts of money in constructing and maintaining levees with which to form barriers against the entry of the river into the valley and into the Salton Sea. In order that protection may be provided for flood damage, and in order that additional water above that now used may be conserved for low flow seasons, and to serve for the extension of the irrigable area: it is necessary that impounding works be constructed at some point on the river. The irrigation district has been cooperating with the U. S. Reclamation Service for some years in investigating the best site for such impounding works.

The proposal on the part of the State of California to so plan and protect the interests of Imperial County is of interest to the other states lying within the basin of the Colorado River drainage area, and in order that there may be general community interest and a general working plan adopted by all such states, certain legislation was proposed and passed by all of them during the year 1921. California's Act is expressed in the language of chapter 88, Statutes of 1921, and is as follows:

#### CHAPTER 88.

*An act authorizing the governor of California to appoint a representative of the State of California to serve upon a joint commission composed of representatives of the states of Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming and the United States of America, and constituted for the purpose of negotiating and entering into an agreement between the several states hereinabove mentioned and between said states and the United States of America, subject to the consent of Congress, respecting further use and disposition of the waters of the Colorado River and streams tributary thereto, and*



*fixing and determining the rights of each of said states and rights of the United States in and to the use, benefit and disposition of the waters of said stream and its tributaries.*

(Approved May 12, 1921. In effect immediately.)

*The people of the State of California do enact as follows :*

SECTION 1. The governor of California shall appoint the state engineer who shall serve without additional compensation as the representative of the State of California on a joint commission composed of one representative from each of the states of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, and two duly authorized representatives of the United States of America, the principal duty of which commission shall be to negotiate and enter into an agreement between the several states hereinabove mentioned and between the said states and the United States of America, subject to the consent of Congress, respecting the further use and disposition of the waters of the Colorado River and streams tributary thereto, and fixing and determining the rights of each of said states and the rights of the United States in and to the use, benefit and disposition of the waters of the Colorado River and its tributaries; *provided, however*, that any agreement so entered into by said states and the United States of America shall not be binding or obligatory upon any of the high contracting parties thereto unless and until such agreement shall have been ratified and approved by the legislature of each of the above mentioned states and by the congress of the United States.

SEC. 2. The governor of California, immediately after such representative of the State of California has been appointed and has qualified, shall notify the governor of each of the above mentioned states of the appointment of the said representative of California, giving his name and address, but said representative shall not enter upon the performance of his duties until a representative to serve upon said joint commission shall have been named and qualified for each of the states named in section one hereof.

SEC. 3. Said representative from California shall have full authority to make any and all investigations of the Colorado River and the drainage area thereof, which may become necessary in order to sufficiently advise said representative of the physical conditions obtaining upon said streams, and of the present and future need of the State of California and its citizens to the use and benefit of the waters of said stream. To that end, said representative shall have authority to administer oaths, examine and require the attendance of witnesses, and to perform such other duties as may be necessary to sufficiently apprise said representative of the facts and furnish him with adequate information in order that he may properly perform his duties as representative of the State of California upon said joint commission.

SEC. 4. Inasmuch as the Colorado River during flood periods constitutes a menace to life and property within this state and the purpose of the commission is to meet immediately upon the appointment and qualification of the representatives of the several states for the purpose of adopting a plan of agreement which will ultimately make possible the construction of impounding dams that will eliminate this hazard, it is hereby declared that this act is an emergency measure necessary for the immediate preservation of the public health, peace and safety, and that under the provisions of section one of article four of the state constitution an urgency exists, and this act shall take effect immediately.

Legislation of similar character was adopted by all of the other states. President Harding appointed Mr. Herbert Hoover, Secretary of the Department of Commerce, as the federal member. The Commission met in Washington, D. C., on January 27, 1922, and chose Mr. Hoover as chairman. Meetings and hearings have been held at

Phoenix, Arizona, March 15, 16, 17, 1922.

Los Angeles, California, March 20, 1922.

Salt Lake City, Utah, March 27, 28, 1922.

Grand Junction, Colorado, March 29, 1922.

Denver, Colorado, March 31 and April 1, 1922.

Cheyenne, Wyoming, April 2, 1922.



No agreement was reached.

The Commission is to meet again at Santa Fe, New Mexico, on November 9, 1922, for further discussion.

#### **FLOOD CONTROL—SACRAMENTO AND SAN JOAQUIN VALLEYS.**

(In cooperation with State Reclamation Board.)

In accordance with the \*Reclamation Board Act, this division has continued to make surveys and examinations for the Sacramento Flood Control Project, and for the formulation of flood control plans in the San Joaquin Valley. It has also examined and reported upon applications of various reclamation districts, and other matters referred to it by the Reclamation Board.

Descriptions of the Sacramento Flood Control project and the mining debris problem are contained in previous reports of the State Department of Engineering and of the Reclamation Board.

#### **Installation of Recording Gages.**

In order to supplement the data collected by the United States Weather Bureau on river gage heights during flood periods in the Sacramento Valley, eighteen recording gages were installed during 1921 at various points on the Sacramento River and its tributaries and on the Calaveras and Mokelumne rivers.

The cost of purchasing and installing thirteen of these Bristol gages was paid by the State Reclamation Board.

The three located at Yolo, Winters and Lisbon were purchased by the California Debris Commission, and the cost of installation paid by landowners in Yolo by-pass.

The cost of purchase and installation of the two located at Stockton and Jenny Lind was paid by the city of Stockton.

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\*Chapter 523, p. 1122, Statutes of 1919.

**BRISTOL GAGE INSTALLATIONS.**

Station	Range of record	Staff gage reading of zero of recorder	Staff gage heights above which telegraphic reports are sent in	Staff gage installed by	Elevation of zero of staff gage and datum	Maximum high-water record
Kennett	Feet 30	Feet 10.0	Feet 12.0	U. S. W. B.	Feet 621.6 U. S. E. D.	Feet 33.2—Feb. 23, 1907
Simpson's Bridge (Stony Creek)	30	5.0	5.0	(Orland project)		
Ord Ferry	25	0.0	10.0	U. S. W. B.	98.83 U. S. E. D.	23.5—Feb. 4, 1909
Moulton Break	30	60.0	70.0	State	0.0 U. S. E. D.	32.0—Feb., 1915
Butte Basin, 2.2 miles north of West Butte	20	55.0	60.0	State	0.0 U. S. E. D.	
Colusa	30	10.0	20.0	U. S. W. B.	40.4 U. S. E. D.	29.3—Mar. 29, 1907
Long Bridge	20	45.0	50.0	State	0.0 U. S. E. D.	
Tisdale	20	40.0	Local phone available	District No. 1500	0.0 U. S. E. D.	
Lisbon	20	7.0	Local phone available	State	0.0 U. S. E. D.	
Yolo (Cache Creek)	30	1.0	15.0	U. S. G. S.		27.8—Feb. 2, 1915
Winners (Putah Creek)	30	10.0	25.0	U. S. G. S.	Top of dam	39.0—Dec. 31, 1913
Hammononton (Yuba River)	15	0.0	5.0		0.0 U. S. E. D.	
Yuba City	30	50.0	55.0	Levee, District No. 1	Removed Aug., 1922	
Bear River-Auburn-Grass Valley Road	30	0.0	6.0	State		
Auburn, North Fork American River	50	0.0	9.0	U. S. G. S.		
Coloma, South Fork American River	30	10.0	10.0	State		
Stockton	20	83.0	90.0	Stockton (city)	City datum	
Jenny Lind, Calaveras River	25	4.0	8.0	U. S. G. S.		



Bristol gage installation—South Fork of American River at Coloma.

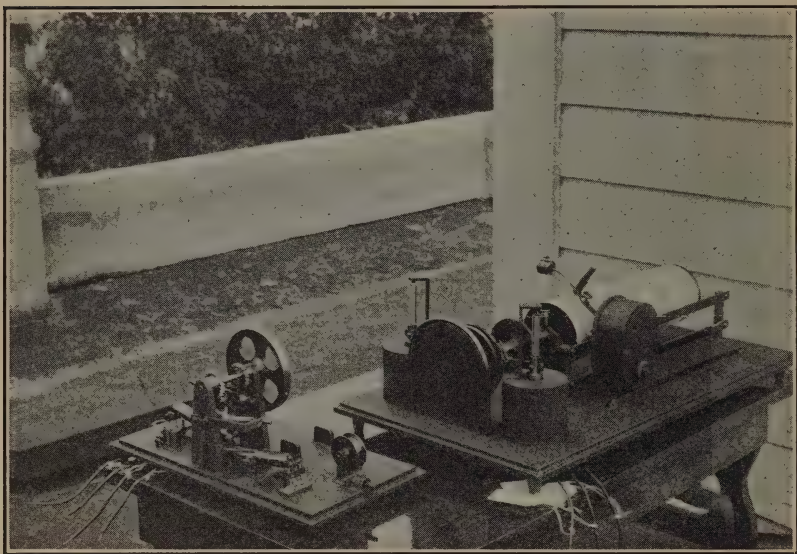
#### **Long Distance Recording Gage.**

The gaging station which records the flow for the Sacramento River is six miles upstream from Red Bluff, at the mouth of Iron Canyon. This is a most important station and immediate information on changing gage height during flood periods is invaluable.

There being no one living near this station to send in reports from the recording gage in the gage house, it was desirable to connect this gaging station with the United States Weather Bureau office in Red Bluff by a long distance recorder. This instrument was installed and keeps a record in the Weather Bureau office at Red Bluff, of the gage heights on the Sacramento River, six miles above.

#### **Flood Discharge Measurements.**

Current meter measurements of flood discharge have been made at various points in the Sacramento and San Joaquin rivers and tributaries as follows:



Stevens long-distance water stage register on Sacramento River.



**FLOOD DISCHARGE MEASUREMENTS.**

Stream	Location	Date	Gage Datum.	Gage height, feet.	Discharge, second-feet	Remarks
Sacramento River-----	Sacramento-----	April 26, 1921	U. S. W. B. gage. Zero equals 8.1 ft. U. S. E. D. Temporary	15.4	48,988	35.6 on temporary gage equals level of deck of highway bridge at south end.
		May 20, 1921		14.6	31,540	
		June 3, 1921		12.6	29,340	
		June 20, 1921		7.68	15,310	
		June 30, 1921		5.5	11,290	
American River-----	Near Sacramento-----	April 27, 1921		48.43	6,091	
Butte Slough By-pass----	Long Bridge-----	Nov. 20, 1920		20,722	20,722	
		Dec. 10, 1920		45.95	5,941	
		Dec. 11, 1920		47.12	10,908	
		Jan. 30, 1921		49.87	39,440	
Sutter By-pass-----	Near Glisizer Slough-----	Dec. 13, 1920	State gage. Zero equals zero U. S. E. D.	37.80	22,127	
		Dec. 14, 1920		38.20	25,113	
		Jan. 22, 1921		40.35	49,401	
		Feb. 2, 1921		41.91	70,040	
		Feb. 17, 1921		36.27	16,852	
Tisdale By-pass-----	Tisdale Weir-----	Dec. 10, 1920	Temporary	45.55	2,745	
		Dec. 11, 1920		46.60	9,725	
		Jan. 18, 1921		32.84	14,521	
		Dec. 21, 1920		30.62	8,810	
		Nov. 29-30, 1920		2.93	3,673*	
San Joaquin River-----	San Joaquin City-----	Jan. 19, 1921	U. S. W. B. gage near Lathrop. Zero equals 5.5 ft. U. S. E. D.	2.66	3,206	In cooperation U. S. G. S. and City of Stockton.
San Joaquin River-----	Lathrop-----	Jan. 20, 1921		4.23	4,805	
		Jan. 20, 1921		12.06	13,179	
		Jan. 22, 1921		12.55	14,648	
		Jan. 27, 1921		14.34	16,082	
		May 15, 1922		10.55	10,580	
		May 15, 1922		12.95	14,433	
		May 18, 1922		12.97	14,688	
		June 1, 1922		15.50	20,900	
		June 9, 1922		17.28	22,300	

\*Gage measurement at San Joaquin City referred to U. S. Weather Bureau gage near Lathrop.

FLOOD DISCHARGE MEASUREMENTS—Continued.

Stream	Location	Date	Gage Datum.	Gage height, feet	Discharge, second-foot	Remarks
San Joaquin River-----	Durham Ferry Bridge-----	July 12, 1922		11.18	10,600	
San Joaquin River-----	Below Middle River, Brandt Bridge-----	May 16, 1922		10.17	10,000	
		May 19, 1922	Zero equals 3.4 ft.	11.800	11,800	
		June 2, 1922	U. S. E. D.	12.83	12,700	
Brandt-----		June 10, 1922		13.17	12,600	
Middle River-----	Below Salmon Slough, Mowrey Bridge-----	May 16, 1922		4.92	1,920	
		June 2, 1922	Zero equals 6.6 ft.	6.53	2,370	
		June 10, 1922	U. S. E. D.	7.80	2,680	
		May 15, 1922		8.60	3,160	
Paradise Cut-----	Highway Bridge-----	May 18, 1922		4.85	2,360	
		June 1, 1922	Zero equals 10.67 ft.	8.25	5,690	
		June 9, 1922	U. S. E. D.	9.90	9,060	
Old River-----	Below Tom Paine Slough at Bridge-----	May 16, 1922		10.70	10,600	
		June 13-14, 1922	Zero equals zero	6.93	1,690	
			U. S. E. D.	10.23	4,400*	
Grant Line Canal-----	Near Lathrop-----	June 13-14, 1922	Zero equals 8.5 ft.	0.88	13,700*	
San Joaquin River**-----	Half mile below Stockton channel-----	Dec. 2-3, 1920	U. S. E. D.	2.54	1,550	
		Dec. 22-23, 1920		3.07	1,875	
		Jan. 5-6, 1921		4.07	2,165	
		Jan. 17-18, 1921		3.14	2,070	
		Jan. 24-25, 1921		11.39	7,220	
		Feb. 10-11, 1921		6.76	3,910	
		Mar. 1-2, 1921	U. S. W. B. gage.	6.19	3,575	
		Mar. 23-25, 1921	Zero equals 5.5 ft.	6.66	3,895	
		April 29-30, 1921	U. S. E. D.	7.41	4,175	
		June 9-10, 1921		13.81	8,240	
		June 23-25, 1921		9.18	4,954	

In cooperation U. S. G. S. and City  
of Stockton (no check).

\*Mean discharge for tidal cycles in cooperation with U. S. G. S. and City of Stockton. Mean discharge for tidal cycle.

\*\*Measurement taken half mile below Stockton channel and referred to U. S. Weather Bureau gage near Lathrop same day.

#### Progress on Plans for Flood Control.

*Upper Colusa Basin Flood Channel.* A flood channel is required for the flood waters carried by the various streams that enter the Upper Colusa Basin from the west. As these streams enter the basin at intervals, the flood channel was required to have a varying capacity, increasing in the downstream direction. The dimensions of this channel have been determined and its course located during the past biennium.

*Cherokee Canal.* An estimate of the quantity of flood waters which may be expected in Cherokee Canal was made from a study of rainfall records in the vicinity of its watershed and a determination of the flood channel necessary for this run-off.

*Mokelumne River.* A study of the run-off per square mile of the streams on both sides of the Mokelumne River watershed was made for the purpose of determining what run-off might reasonably be expected from the Mokelumne drainage basin for a storm having its full intensity over that watershed, it being conceded that the intensity of both the 1907 and 1911 storms was greatly diminished before reaching this area, the one being more intense to the north, and the other to the south.

Studies of flood control on the Mokelumne River were made, including the probable effect on conditions in case proposed reservoirs should be constructed in the foothill area of this watershed.

It was found that the north and south forks of the river could be widened as far as necessary below New Hope Landing to care for the run-off at considerably less cost than by the construction of any by-pass.

If, however, the proposed reservoirs should be built with sufficient intake canal capacity, and operated with the object of controlling the flood waters, the only work necessary on the north and south forks would be the raising of the levees to a standard grade and section.

#### San Joaquin Valley.

A careful study and revision of the analysis of the 1911 flood, including the possible effect upon such a flood by construction of reservoirs contemplated on the San Joaquin River and its tributaries, were made in conjunction with studies of various plans for flood channels in this valley.

From the studies for the San Joaquin Valley, plans have been worked out for the upper end of the San Joaquin by-pass; setting levee heights and grades.

#### Applications Before Reclamation Board.

Investigations and reports have been made to the Reclamation Board upon eighty-three applications for reclamation and drainage works, including pumping plants, and upon four applications for the construction or reconstruction of bridges over river and flood channels in the Sacramento and San Joaquin valleys. Various complaints of land owners and districts have also been investigated and reported upon.

#### Levee Standardization.

Plans for the completion to standard grade and the protection of the east levee of the Sacramento River from Reclamation District No. 744 to Reclamation District No. 755, a distance of 4.3 miles, were completed and reported to the Reclamation Board.

Plans, profiles and levee sections showing work necessary to bring the levee to standard grade have been reported to the Reclamation Board covering the east levee of the Sacramento River from Sacramento City to Portuguese Bend below Freeport, a distance of 10.7 miles and from Reclamation District No. 551 to the mouth of Old River, a distance of 13.8 miles, also for the west levee of the Sacramento River along Reclamation Districts Nos. 765 and 307, a distance of 8.3 miles.

**Annual Report of Local Expenditures on the Sacramento  
Flood Control Project.**

Two annual reports have been prepared, showing the amounts expended by local interests upon various portions of the Sacramento flood control project. The 1922 report shows a total expenditure by various districts, cities, and private interests amounting to \$28,035,887.76. State appropriations for this project have been made amounting to \$2,850,000, making a grand total of \$30,885,887.76.

The accumulative expenditures by local interests, state and federal governments, upon reclamation works forming portions of the Sacramento project are shown graphically on Diagram No. 2.

**COOPERATIVE INVESTIGATIONS WITH FEDERAL GOVERNMENT.**

**Restraining Debris—Yuba River.**

The California Debris Commission has constructed additional works in the bed of the Yuba River during the past two years. This construction work is located above Marysville and was undertaken for the purpose of confining the large volume of debris deposited there since the days of hydraulic mining. Without retention this debris would be washed downstream to fill the channels of the Feather and Sacramento rivers and obstruct navigation.

The work has consisted of constructing dams across the heads of old channels where the river had threatened to enter and scour out the sand deposits. The cobble and earth retaining wall previously built to guide the river through the debris deposits had protecting parts added to it. Also many snags were removed from the channel, hard pan blasted, overhanging trees cut from the banks, and bank protection placed at a caving bend in the river six miles upstream from Marysville.

This work has been carried on by the California Debris Commission, and funds have been supplied equally by the state and federal governments.

**STREAM GAGING.**

Progress Report by H. D. MCGLASHAM, District Engineer, Water Resources Branch,  
United States Geological Survey.

The cooperative investigation of the surface water resources of the State of California during the years 1921 and 1922 has been maintained on about the same basis as given in your last biennial report, except that through cooperation with permittees and licensees of the Federal Power Commission, 23 new stations have been established. These stations are all located at high elevations and will furnish very valuable run-off records.



The following table gives the river measurement stations maintained during the two-year period ending September 30, 1922. This list does not include stations maintained by private parties, for which complete records are furnished for publication in our annual progress reports. These stations are distributed among the major drainage basins of the state as follows: Sacramento 27 per cent, San Joaquin 33 per cent, South Pacific 27 per cent, North Pacific 6 per cent, and Great Basin 7 per cent.

Stream.	Location.
Alameda Creek*	Niles
American River	Fairoaks
American River, Middle Fork	East Auburn
American River, North Fork	Colfax
American River, South Fork	Placerville
Antelope Creek*	Macdoel
Arroyo Seco*	Pasadena
Arroyo Seco	Soledad
Bear Creek	Dana
Bear Creek*	Macdoel
Bear Creek*	Vermillion Valley
Bear River	Colfax
Bear River	Van Trent
Black Canyon Creek	Mesa Grande
Boulder Creek	Julian
Burney Creek	above Burney
Burney Creek at Burney Falls	Burney
Butte Creek*	Macdoel
Cache Creek	Yolo
Cajon Creek*	Keenbrook
Calaveras River	Jenny Lind
Carson River, East Fork	Markleeville
Carson River, West Fork	Woodfords
Cherry Creek*	Hetch Hetchy
Chiquito Creek*	Arnold Meadow
City Creek*	Highlands
Clear Lake	Lakeport
Cosumnes River	Michigan Bar
Cosumnes River, North Fork	El Dorado
Coyote River	Coyote
Coyote River	Edenvale
Coyote River	Madrone
Cuyamaca Water Company's flume at diverting dam	Lakeside
Cuyamaca Water Company's flume	Lakeside
Dalton Creek*	Glendora
Deer Creek	Hot Springs
Deer Creek	Vina
Devil Canyon Creek*	San Bernardino
Dinkey Creek*	Dinkey Meadows
Dinkey Creek*	at mouth
Eaton Creek*	Pasadena
Eel River	Scotia
Eleanor Creek*	Hetch Hetchy
Eleanor Lake	Hetch Hetchy
Elsinore Lake	Elsinore
Fall River	Fall River Mills
Fall River*	Glenburn
Falls Creek*	Hetch Hetchy
Feather River*	Nicolaus
Feather River*	Oroville
Feather River, Middle Fork	Oroville
Feather River, Middle Fork*	Sloat

\*Station equipped with a water-stage recorder.

Stream.	Location.
Feather River, South Fork	Enterprise
Fish Creek*	Duarte
Fresno River	Knowles
Gobernador Creek	Carpinteria
Goodyear Creek	Goodyear Bar
Granite Creek*	Granite Creek bridge
Haines Creek*	Tujunga
Hat Creek*	Carbon
Hat Creek at Wilcox Ranch	Cassel
Helms Creek*	near mouth
Indian Creek	Happy Camp
Jackass Creek*	Jackass Meadows
Kaweah River	Three Rivers
Kaweah River, North Fork	Kaweah
Kaweah River, South Fork	Three Rivers
Kern River*	Kernville
Kern River No. 3 canal*	Kernville
Kings River*	Hume
Kings River*	Sanger
Kings River, North Fork*	Chff Camp
Kings River, North Fork*	above Dinkey Creek
Kings River, North Fork*	below Meadow Brook
Klamath River	Requa
Klamath River	Seiad Valley
Little Santa Anita Creek*	Sierra Madre
Lone Pine Creek*	Keenbrook
Long Valley Creek	Scotts
Lytle Creek and Fontana pipeline*	Fontana
Markleeville Creek	Markleeville
Markleeville Creek	above Markleeville
McArthur drainage canal	McArthur
McCloud River	Baird
Medley Lakes outlet*	Echo
Meeks and Daley canal*	Colton
Merced River*	Exchequer
Merced River*	Livingston
Merced River at Happy Isles*	Yosemite
Merced River at Pohono bridge*	Yosemite
Merced River, South Fork	Wawona
Middle Eel River	Covelo
Mill Creek*	Craftonville
Mill Creek power canal No. 1*	Craftonville
Mill Creek power canal Nos. 2 and 3*	Craftonville
Modesto Canal	La Grange
Mokelumne River	Clements
Mokelumne River, Middle Fork	West Point
Mokelumne River, South Fork	Railroad Flat
Mono Creek*	Vermillion Valley
Mono Lake	Mono Lake
Monrovia pipeline	Monrovia
Oakdale Canal	Knights Ferry
Oregon Creek	North San Juan
Owens Lake	Lone Pine
Owens River	Big Pine
Owens River*	Round Valley
Pacoima Creek*	San Fernando
Palermo Land and Water Company's canal	Enterprise
Pauma Creek*	Nellie
Pauma Creek at Pauma Indian Reservation*	Nellie
Pine Creek	Asturas
Pine Creek	Round Valley

\*Station equipped with a water-stage recorder.

Stream.	Location.
Pit River	Bieber
Pit River below Fall River*	Fall River Mills
Pit River*	Henderson
Pit River*	Pecks bridge
Pit River	Ydalpom
Pitman Creek*	Big Creek
Plunge Creek*	East Highlands
Putah Creek	Winters
Rising River	Cassel
Rock Creek	Goodyear Bar
Rock Creek	Round Valley
Rogers Creek*	Azusa
Sacramento River	Antler
Sacramento River*	Butte City
Sacramento River	Castella
Sacramento River*	Colusa
Sacramento River*	Knights Landing
Sacramento River*	Red Bluff
Salmon Creek*	Kernville
Salton Sea	Salton
San Antonio Creek*	Claremont
San Diego River*	Santee
San Dimas Creek*	San Dimas
San Gabriel River*	Azusa
San Jacinto River*	Elsinore
San Jacinto River*	San Jacinto
San Joaquin River	Big Creek
San Joaquin River*	Friant
San Joaquin River	Newman
San Joaquin River*	Vernalis
San Joaquin River, Middle Fork*	Miller Bridge
San Joaquin River, North Fork*	Iron Creek
San Joaquin River, South Fork*	Hoffman Meadows
San Joaquin River, South Fork*	Lake Florence
San Luis Rey River	Bonsall
San Luis Rey River*	Mesa Grande
San Luis Rey River, West Fork*	Nellie
San Pablo Creek	San Pablo
San Pablo Creek	Near San Pablo
Santa Ana River*	Mentone
Santa Ana River*	Prado
Santa Anita Creek*	Sierra Madre
Santa Ysabel Creek*	Mesa Grande
Santa Ysabel Creek*	Ramona
Santiago Creek*	Villa Park
Sawpit Creek*	Monrovia
Scott River	Callahan
Scott River, East Fork	Callahan
Serrano and Carpenter canal*	Villa Park
Sespe Creek	Sespe
Shasta River	Montague
Shaver flume*	Shaver
Sierra & San Francisco Power Company's canal	La Grange
Silver Creek*	Placerville
Silver Lake outlet*	Kirkwood
Southern California Edison Company's canal	Azusa
Southern California Edison Company's canal	Claremont
Silver Lake outlet*	Kirkwood
South San Joaquin canal*	Knights Ferry
Spanish Creek	Keddie
Stanislaus River*	Knights Ferry
Stanislaus River, North Fork	Avery

\*Station equipped with a water-stage recorder.

Stream.	Location.
Stevenson Creek*	Shaver
Strawberry Creek*	Arrowhead Springs
Susan River	Susanville
Sutter Creek	Sutter Creek
Sweetwater River	Descanso
Temescal Creek	Elsinore
Tenaya Creek*	Yosemite
Thomas Creek	Paskenta
Trinity River	Lewiston
Tujunga Creek*	Sunland
Tulare Lake	in Kings County
Tule River	Porterville
Tule River, South Fork	Porterville
Tunnel diversion	Azusa
Tuolumne River*	Buck Meadows
Tuolumne River*	Hetch Hetchy
Tuolumne River above La Grange dam*	La Grange
Tuolumne River, Middle Fork*	Buck Meadows
Tuolumne River, South Fork*	Buck Meadows
Turlock canal	La Grange
Twin Lakes outlet*	Kirkwood
Utica Gold Mining Company's canal	Avery
Ventura River	Ojai
Warm Creek*	Colton
Waterman Canyon Creek*	Arrowhead Springs
West Walker River*	Coleville
Yosemite Creek	Yosemite
Yuba River	Smartville
Yuba River, Middle Fork	North San Juan
Yuba River, North Fork	Goodyear Bar
Yuba River, North Fork of North Fork	Downieville

\*Station equipped with a water-stage recorder.

This work has been maintained in accordance with cooperative agreements with the State of California, through the Divisions of Engineering and Irrigation and of Water Rights, Department of Public Works; the city and county of San Francisco, through M. M. O'Shaughnessy, city engineer; Los Angeles County, through the board of supervisors; city of Los Angeles, through the department of public works; San Bernardino, Riverside, and Orange counties, through the boards of supervisors; United States Forest Service; United States Weather Bureau; United States Indian Service, and National Park Service. In addition, the following public service companies have furnished very substantial cooperation: Pacific Gas and Electric Company, Spring Valley Water Company, San Joaquin Light and Power Corporation, Southern California Edison Company, Southern Sierras Power Company, and Western States Gas and Electric Company. Also, assistance has been furnished by irrigation districts, private companies, and individuals.

The amount of work done and its costs, including estimated expenditures for complete records furnished free for publication, for the two-year period ending June 30, 1922, were as follows:



STREAM GAUGING PROGRESS AND EXPENDITURES.

June 30, 1920 to June 30, 1922.

Drainage	Number of stations			Number of discharge measurements			Cost		Average cost per station of 12 months record, including new construction, top cost and office work.
	Established	Discontinued	Maintain June 30, 1922	At regular stations	Miscellaneous	Total	Operation and maintenance	New construction	
Sacramento -----	21	0	57	538	88	626	\$11,236 74	\$10,749 78	\$323 18
San Joaquin -----	24	0	72	1666	223	1889	83,907 49	56,144 18	1,194 36
South Pacific -----	11	3	58	2334	758	3092	22,661 14	4,779 08	853 76
North Pacific -----	3	0	9	122	1	123	2,260 90	1,683 44	337 54
Great Basin -----	0	0	14	119	19	138	2,259 84	0	123 20
Totals -----	59	3	210	4779	1089	5863	\$122,326 11	\$73,356 48	

In my last report emphasis was placed upon the necessity for a rapid development of all feasible storage, to meet the then urgent irrigation and power requirements, and it was recommended that a thorough study be made of the storage possibilities throughout the state. You are now completing a comprehensive survey of the water resources of the state which includes a thorough study of storage possibilities. To supplement this work, additional funds should be made available for construction and maintenance of new river measurement stations, to be established at each feasible reservoir site and at other critical points where your studies show the necessity for additional stream flow records. Also it is highly desirable to install additional water-stage recorders on all main streams, especially in the Sacramento and San Joaquin drainages, in order that more complete and accurate records will be available in advance of actual developments.

An unpublished report has been prepared covering the developed water power in California. There are 133 water power plants in the state, having a capacity of 100 horsepower or more, with a total installed capacity of 1,239,839 horsepower. The average capacity per plant is 9322 horsepower and the average horsepower per wheel unit is 3734. The maximum head developed is 2131 feet and the minimum 10 feet. Shasta County leads all other counties in the state in developed water power, its 12 plants having a total installed capacity of 181,450 horsepower. The total installed capacity of water power plants, in each of the major drainage basins in California, is as follows:

TOTAL INSTALLED CAPACITY OF WATER POWER PLANTS ON THE MAJOR DRAINAGE BASINS OF CALIFORNIA.

Drainage basin from which water is diverted	Number of plants	Total installed horsepower
Sacramento -----	48	532,862
San Joaquin -----	35	472,263
Great Basin -----	22	163,675
North Pacific -----	12	45,934
South Pacific -----	16	25,105
Totals -----	133	1,239,839

In the United States there are 3120 water power plants of 100 horsepower or more, with a total capacity of installed water wheels of 7,926,958 horsepower. New York ranks first, with 1,291,875 horsepower; California is a close second, with 1,239,839 horsepower; Washington is third, with 454,356 horsepower; Maine closely follows in fourth place, with 449,614 horsepower; and Montana is fifth, with 344,420 horsepower.

Although occupying second place among the states of the Union in capacity of water power plants, California, in 1921, ranked first in the production of hydro-electric power, furnishing 21.6 per cent of the total for the United States and making a gain of 5.7 per cent over 1920. New York came second with 14.7 per cent of the total, a loss of 4.1 per cent over 1920; and Washington third with 7.6 per cent, a gain of 0.5 per cent.

The following Surface Water-Supply Papers, containing California records, have been published since your last biennial report:

Paper 447, Surface Water Supply of the Pacific Slope of Southern California, which contains all stream flow records collected in Southern California to September 30, 1918.

Paper 460, Annual Progress Report of Great Basin for the year ending September 30, 1917.

Paper 461, Annual Progress Report of California for the year ending September 30, 1917.

Paper 481, Annual Progress Report of California for the year ending September 30, 1918.

Water-Supply Paper 480, for 1918; 510 and 511, for 1919 and 1920, and 530 and 531, for 1921, are in process of publication. All California records included in these unpublished reports and many complete records for 1922 are now available for distribution upon application to this office. In addition, monthly summaries of stream flow, for all the years of record, have been compiled for all river measurement stations now in operation. These tables are very convenient for the public as many of the Water-Supply Papers are out of print and the latest records are not yet available in printed form.

In the administration of the work of the Water Resources Branch of the Geological Survey, the district office is maintained at 328 Custom House, San Francisco. A sub-office is retained at 602 Federal Building, Los Angeles, for the convenience of southern California and as a headquarters for work in the South Pacific drainage. Records of stream flow for all sections of the United States and data collected by other branches of the Survey may be consulted at either office.

The water resources investigation in California is under the general supervision of Mr. N. C. Grover, chief hydraulic engineer, and Mr. John C. Hoyt, hydraulic engineer in charge of surface waters for the Geological Survey.

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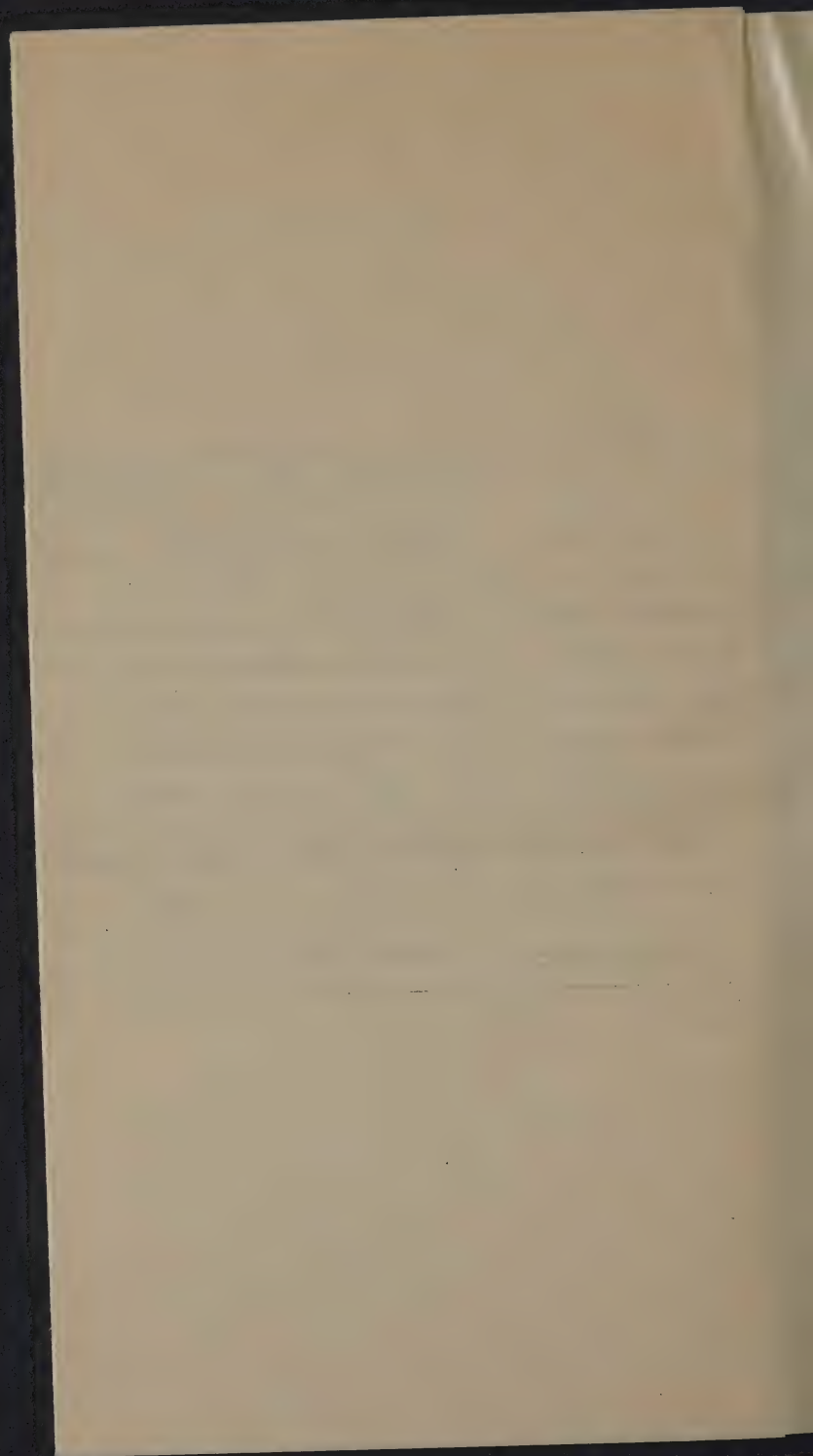
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The water resources investigation in California is under the general supervision of Mr. N. C. Grover, chief hydraulic engineer, and Mr. John C. Hoyt, hydraulic engineer in charge of surface waters for the Geological Survey.



## ANNUAL SUMMARY REPORT OF STREAM GAGING FOR FISCAL YEAR 1922.

ANNUAL SUMMARY REPORT OF STREAM GAGING FOR FISCAL YEAR 1922																										
District	EXPENDITURES						EMPLOYEES			RECORDS									COST							
	Federal	COOPERATIVE				Total	Classified	Unclassified	Total men, months of 30 days	Number of gaging stations			Number of months' record		Number of discharge measurements				MEAN		PRINCIPAL ITEMS					
		Federal	State	Miscellaneous	Estimated cost of data furnished					Established	Discontinued	Maintained end year	Total	Average per station	Regular stations	Miscellaneous	Total	Per station of 12 months' record	Per station of 12 months' record	Per month's record	Observers	Operations and maintenance, including observers	Construction	Office work	Top cost	Non-expendable property
Sacramento -----	\$1,317 84		\$7,143 72	\$12,123 60	\$975 00	\$21,560 16			28.1	19		57	581	10.2	355	21	376	7.3	445.31	37.11	\$2,271 07	\$7,055 18	\$10,303 77	\$2,653 26	\$1,458 81	\$89 14
San Joaquin-----	1,723 40	\$610 00	6,741 83	128,814 48	1,530 00	139,419 71			44.2	24		72	763	10.6	1,523	147	1,670	24.0	2,192.72	182.72	2,079 61	78,592 58	55,801 48	2,887 68	2,042 12	95 85
South Pacific-----	2,742 39	1,613 95	6,139 64	6,056 95	3,730 00	20,282 93			57.5	4		58	691	11.9	1,235	409	1,644	21.4	352.24	29.35	1,495 00	11,411 20	1,611 60	3,460 44	3,589 22	210 47
North Pacific-----	217 56		1,407 01	1,979 17	60 00	3,663 74			2.7	3		9	88	9.8	100	1	101	13.6	499.62	41.64	630 83	1,539 12	1,683 44	180 19	257 16	3 83
Great Basin-----	42 87		382 84		955 00	1,380 71			1.3			14	139	9.9	65	1	66	5.6	119.20	9.93	569 66	1,038 74		278 98	62 03	96
Total Cal. streams----	\$6,044 06	\$2,223 95	\$21,815 04	\$148,974 20	\$7,250 00	\$186,307 25	11		133.8	50		210	2,262	10.8	3,278	579	3,857	17.4	988.37	82.36	\$7,046 17	\$99,636 82	\$69,400 29	\$9,460 55	\$7,409 34	\$400 25
Ground water-----	45 57		99 73	493 80		639 10																				
California totals-----	\$6,089 63	\$2,223 95	\$21,914 77	\$149,468 00	\$7,250 00	\$186,946 35																				



### UNDERGROUND WATERS.

Progress Report by C. E. MEINZER, Geologist in Charge, Division of Ground Waters,  
United States Geological Survey.

The following reports were published during the biennial period as water-supply papers:

Water-Supply Paper 468. Records of water levels in wells in Southern California, by F. C. Ebert, 1921. 156 pp. 4 pls. Many of these records have been published in different reports, but the present volume brings together all the records, including the unpublished data obtained in recent years.

Water-Supply Paper 490-a. Routes to desert watering places in the Salton Sea region, California, by J. S. Brown, pp. 1-86, pls. i-vii. This guide-book contains concise but specific directions for finding practically all watering places in a desert area of 10,000 square miles, together with two large relief maps on which the watering places and connecting roads are shown.

Water-Supply Paper 490-b. Routes to desert watering places in the Mohave Desert region, California, by D. G. Thompson, pp. i-vii, 1-4, 87-269, pls. i-iv, viii-xvii. This guidebook is similar to Water-Supply Paper 490-a. It covers, in like detail, an area of about 25,000 square miles in San Bernardino and adjacent counties. It contains five large relief maps.

One comprehensive report, "Geology and ground-water resources of Sacramento Valley, California," by Kirk Bryan, is in press and will be issued in the near future as Water-Supply Paper 495.

Three reports were completed but not published because of lack of funds. They were, however, made available to the public by being filed in the branch offices of the United States Geological Survey at San Francisco or Los Angeles, where they can be consulted by all interested persons. These reports are as follows:

"Ground Water in Santa Clara Valley, California," by W. O. Clark.

"Available Supply of Ground Water in Antelope Valley, California, with notes on recent developments," by D. G. Thompson.

"Ground Water Resources of Mohave Valley, California," by D. G. Thompson.

The following report has been completed for some time and is still awaiting publication:

"The Salton Sea Region, California, a Geographic, Geologic, and Hydrologic Reconnaissance," by John S. Brown. This report covers the same region as is covered by Water-Supply Paper 490-a. It will be a rather large volume, full of new information of much scientific and practical value.

A large report entitled "The Mojave Desert Region, California, a geographic, geologic, and hydrologic reconnaissance," by David G. Thompson, has been nearly completed.

A brief report on ground water in the Napa Quadrangle has been prepared by Norah E. Dowell on the basis of field work previously done by W. O. Clark. This report will be included in the forthcoming geologic folio on the Napa Quadrangle.

A brief investigation and report was made by Kirk Bryan in regard to an increased water supply for the Mariposa Grove of Yosemite National Park. A brief report in regard to a water supply on San Miguel Island was made by D. G. Thompson.

Water levels were measured in selected wells in Southern California, as in previous years, under the direction of F. C. Ebert.

### TOPOGRAPHIC MAPPING.

Progress Report by THOS. G. Gerdine, Topographic Engineer. United States Geological Survey.

In accordance with the cooperative agreements signed July, 1920, and August, 1921, by George Otis Smith, Director, for the United States Geological Survey, and by W. F. McClure, State Engineer, for the State of California, the Federal Survey allotted \$14,000 each year and the state an equal amount for cooperative topographic surveys in the State of California for the fiscal years ending June 30, 1921, and June 30, 1922.

The following is a summary of the field and office work accomplished during the above periods under the general direction of C. H. Birdseye, chief topographic engineer, and under the immediate supervision of George R. Davis, topographic engineer in charge of the Pacific division, and T. G. Gerdine, his successor.

The office drafting of the Academy, Biola, Chaney Ranch, Clovis, Firebaugh, Fresno, Herndon, Kearney Park, Kerman, Laguna Seca, Little Panoche, Malaga, Monocline Ridge, Nos. 21, 25, 27, Orangedale School, Reedley Special, Round Mountain, Sanger, Sheep Ranch, Squaw Valley, Sultana, Tierra Loma School, Tufts Ranch, and Wahtoke topographic maps was completed, and the maps are being transmitted for engraving.

Progress in the drafting of additional sheets was made as follows: Klink, 9 per cent; Mendota, 90 per cent; No. 26, 90 per cent; Tumey Hills, 90 per cent.

Primary level circuits were adjusted for 31 quadrangles.

Geographic positions were computed for 50 quadrangles.

### IRRIGATION INVESTIGATIONS.

Progress Report by SAMUEL FORTIER, Associate Chief, Division of Agricultural Engineering, United States Department of Agriculture.

Work in California under the cooperative agreement between the State Department of Engineering (later the State Department of Public Works) and the Division of Agricultural Engineering, Bureau of Public Roads, has embraced in the main the following activities:

- a. Revision of irrigation map of California.
- b. Establishment of duty of water and irrigation experiments with alfalfa at the State Land Settlement Colony at Delhi.
- c. Continuation of work on reports of the silt problems of Colorado River and Imperial Valley.
- d. Cost of water under southern California irrigation systems.
- e. Organization and operation of mutual water companies in California.

Work under the first two headings has been in cooperation with the Division of Irrigation Investigations and Practice of the College of Agriculture, University of California. In addition some assistance has been rendered on problems under investigation by the Division of Irrigation Investigations and Practice of the College of Agriculture in which the State Department of Public Works and the Division of



**FIELD WORK—TOPOGRAPHIC MAPPING.**

Quadrangles	Counties	Publica- tion scale	Area mapped square miles	Primary levels		Sec'dy traverse miles	Triangulation	
				Miles	Bench marks		Station occupied	Station marked
Auckland -----	Tulare	1:31,680	1	-----	-----	-----	-----	-----
Biola -----	{ Fresno	1:31,680	60	-----	-----	-----	1	-----
Chaney Ranch -----	{ Madera	1:31,680	60	-----	-----	-----	-----	-----
Clovis -----	{ Fresno	1:31,680	60	-----	-----	-----	-----	-----
Firebaugh -----	{ Fresno	1:31,680	60	-----	-----	-----	-----	-----
Fresno -----	{ Madera	1:31,680	60	-----	-----	-----	1	-----
Helm -----	{ Fresno	1:31,680	60	-----	-----	-----	3	3
Herndon -----	{ Fresno	1:31,680	60	-----	-----	-----	1	1
Jamison -----	{ Madera	1:31,680	60	-----	-----	-----	2	-----
Kearney Park -----	{ Fresno	1:31,680	60	-----	-----	-----	4	-----
Kerman -----	{ Fresno	1:31,680	60	-----	-----	-----	2	-----
Malaga -----	{ Fresno	1:31,680	60	-----	-----	-----	1	1
Mendota -----	{ Fresno	1:31,680	60	-----	-----	-----	-----	-----
Monocline Ridge -----	{ Madera	1:31,680	39	-----	-----	-----	-----	-----
No. 21 -----	{ Fresno	1:31,680	54	-----	-----	-----	-----	-----
No. 25 -----	{ Madera	1:31,680	60	-----	-----	-----	1	1
No. 26 -----	{ Fresno	1:31,680	60	-----	-----	-----	1	1
No. 27 -----	{ Tulare	1:31,680	30	-----	-----	-----	-----	-----
No. 31 -----	{ Fresno	1:31,680	-----	-----	-----	-----	2	1
No. 32 -----	{ Fresno	1:31,680	-----	-----	-----	-----	1	1
Oil City -----	{ Fresno	1:31,680	-----	-----	-----	-----	4	1
Orangedale School -----	{ Fresno	1:31,680	18	-----	-----	-----	-----	-----
Raisin -----	{ Fresno	1:31,680	-----	-----	-----	-----	3	2
Reedley Special -----	{ Fresno	1:31,680	60	-----	-----	-----	-----	-----
Round Mountain -----	{ Tulare	1:31,680	60	-----	-----	-----	-----	-----
Sanger -----	{ Fresno	1:31,680	53	-----	-----	-----	-----	-----
Squaw Valley -----	{ Fresno	1:31,680	36	-----	-----	-----	-----	-----
Sultana -----	{ Tulare	1:31,680	60	-----	-----	-----	-----	-----
Tierra Loma School -----	{ Fresno	1:31,680	17	-----	-----	-----	-----	-----
Tranquillity -----	{ Fresno	1:31,680	-----	-----	-----	-----	1	-----
Tufts Ranch -----	{ Fresno	1:31,680	60	-----	-----	-----	-----	-----
Tumey Hills -----	{ Fresno	1:31,680	20	10	2	-----	-----	-----
Wahotoke -----	{ San Benito	1:31,680	60	-----	-----	-----	-----	-----
Wheatville -----	{ Fresno	1:31,680	-----	-----	-----	-----	1	-----
Totals -----	-----	-----	1228	10	2	-----	29	12

Agricultural Engineering, Bureau of Public Roads, has a mutual interest with the College of Agriculture, namely, studies of soil moisture, soil moisture movements as affected by irrigation, cultivation and the growth of crops generally, irrigation of deciduous orchards, and the irrigation of field crops. Efforts along the foregoing lines have been supplemented by general assistance to the State Engineer in the matter of irrigation district organization and irrigation district legislation and to communities which have requested our aid in connection with miscellaneous movements and problems such as the organization of irrigation districts and mutual water companies, water requirements of crops, duty of water, underground water conditions, general irrigation organization, opportunities for both underground and surface storage, need for drainage especially in relation to irrigation, cost of irrigation water, etc. Since the close of the biennium an important new field of work has been begun relating to extent and prevention of seepage losses and economic questions connected therewith.

### *Irrigation Map of California.*

The irrigation map of California prepared jointly by the Department of Public Works, the Division of Irrigation Investigations and Practice of the California Agricultural Experiment Station, and the Division of Agricultural Engineering of the U. S. Bureau of Public Roads, has been issued during the year and distributed widely. It is printed in nine different shades or colors on a scale of 8 miles to the inch, and is issued mainly as separates embracing northern, central and southern California. A limited edition has also been printed in 4 sheets to mount as a single map of the entire state, measuring 79 by 93 inches. This map is available without charge on application to any of the agencies concerned in its preparation.

The features shown on the map, in addition to the most complete and accurate base thus far assembled for the entire state, include the following: irrigable areas, irrigated areas, principal irrigation canals, principal power canals, principal U. S. Geological Survey and private stream-gaging stations, principal U. S. Weather Bureau and private rainfall stations, hydro-electric plants, and relief, the latter being executed and published from topographic sheets and unpublished data by John H. Renshawe, the leading relief artist of the U. S. Geological Survey. An edition of 10,000 each of the separate maps of northern, central, and southern California was printed, also a limited edition of 2000 of a full state map combining into a single map all of the data presented in the three separate maps.

In connection with the preparation of the irrigation map, a new tabulation has been made of the agricultural and irrigated areas of the state as of 1920-1921. This shows a total agricultural area of 23,912,100 acres and a total irrigated area of 5,999,300 acres, the latter figure including all land for which irrigation facilities have been provided and not abandoned and which are irrigated annually or as needed whenever water is available. This is an increase of 2,046,900 acres in the total agricultural area and of 2,806,654 acres in the total irrigated area over the areas shown on the irrigation map issued in 1912. Furthermore, the irrigated area for 1920-1921 is an increase of 1,780,260 acres over the figures obtained by the 1920 irrigation census, the census figures relating only to the areas actually receiving water in 1919. The new tabulation is as follows:

**SUMMARY OF AGRICULTURAL AND IRRIGATED AREAS IN CALIFORNIA AS SHOWN ON 1922 REVISION OF IRRIGATION MAP  
OF CALI FORNIA.**

County	Valley		Plains		Foothill		All classes	
	Total agricultural area, Acres	Irrigated area, Acres	Total agricultural area, Acres	Irrigated area, Acres	Total agricultural area, Acres	Irrigated area, Acres	Total agricultural area, Acres	Irrigated area, Acres
Alameda	118,200	14,200					118,200	14,200
Alpine	4,800	4,800					4,800	4,800
Amador			1,400		153,400	200	154,800	200
Butte	304,600	85,600	81,700	3,700	163,900	8,900	550,200	98,200
Calaveras					195,900	100	195,900	100
Colusa	383,000	135,200					425,400	135,200
Contra Costa	161,900	67,300	42,400	500			161,900	67,300
Del Norte							41,000	
El Dorado	41,000				235,600	6,100	235,600	6,100
Fresno	1,536,000	585,700	75,000	14,700	1,700		1,612,700	600,400
Glenn	307,000	118,500	77,800	1,000			384,800	119,500
Humboldt	112,700	2,500					112,700	2,500
Imperial	891,100	463,900					891,100	463,900
Inyo	348,200	70,700					348,200	70,700
Kern	1,809,700	320,100	295,300	1,000			2,105,000	321,100
Kings	729,700	445,000					729,700	445,000
Lake	54,800	1,400					54,800	1,400
Lassen	570,200	62,300					570,200	62,300
Los Angeles	1,064,300	307,300					1,064,300	307,300
Madera	387,000	136,200	108,700	100	38,700		534,400	136,300
Marin	31,900	300					31,900	300
Mariposa			500		180,900		181,400	
Mendocino	86,900	2,500					86,900	2,500
Merced	737,700	384,800					989,300	388,500
Modoc	376,100	121,000	151,700	3,600	79,900	100	376,100	121,000
Mono	292,800	59,500					262,800	59,500
Monterey	319,000	72,000					319,000	72,000
Napa	73,500	2,500					73,500	2,500
Nevada					170,600	4,400	170,600	4,400
Orange	278,600	149,600					278,600	149,600
Placer	80,500	900	61,600	1,900	153,200	33,200	295,600	36,000
Plumas	115,800	33,900			5,100		120,900	33,900
Riverside	930,800	173,100					930,800	173,100
Sacramento	380,300	119,400					626,400	130,400
San Benito	95,000	23,300	184,600	10,300	61,500	700	95,000	23,300
San Bernardino	1,715,800	126,800					1,715,800	126,800
San Diego	595,300	42,300					595,300	42,300



San Francisco	400	400	100,600	1,600	28,800	400	806,100	400	304,000
San Joaquin	677,200	302,600	8,200	---	---	---	137,500	---	8,200
San Luis Obispo	137,500	12,200	---	---	---	---	64,000	---	12,200
San Mateo	54,000	16,700	---	---	---	---	247,300	---	16,700
Santa Barbara	247,300	95,400	---	---	---	---	203,700	---	95,400
Santa Clara	203,700	1,700	---	---	---	---	33,100	---	1,700
Santa Cruz	33,100	44,700	126,900	4,400	135,600	3,800	394,700	---	52,900
Shasta	132,200	13,900	---	---	---	---	39,800	---	13,900
Sierra	89,500	76,000	---	---	---	---	398,100	---	76,000
Siskiyou	398,100	89,300	85,300	200	---	---	404,600	---	2,000
Solano	319,300	89,300	---	---	---	---	194,900	---	2,000
Sonoma	194,900	2,600	---	---	---	---	635,800	---	244,300
Stanislaus	349,400	221,800	137,700	17,300	148,700	5,200	333,700	---	85,400
Sutter	821,400	85,400	12,300	---	---	---	576,300	---	7,100
Tehama	171,700	44,500	222,300	3,000	182,300	2,000	1,007,500	---	515,400
Trinity	13,500	7,100	---	---	---	---	81,200	---	500
Tulare	882,800	487,800	124,700	27,600	---	500	211,300	---	47,500
Tuolumne	---	47,900	---	---	---	---	464,100	---	124,900
Ventura	211,300	124,600	93,900	300	---	---	278,900	---	27,100
Yolo	370,200	22,400	60,400	1,300	109,300	3,400	---	---	---
Yuba	109,200	---	---	---	---	---	---	---	---
Totals	19,741,200	5,837,800	2,045,100	92,500	2,125,800	69,000	23,912,100	---	5,999,300

### *Water Requirements of Alfalfa.*

The investigations on water requirements of alfalfa have been begun on the experimental irrigation tract on the Land Settlement Colony at Delhi. These are supported by the Division of Irrigation and Engineering, the Division of Agricultural Engineering of the U. S. Bureau of Public Roads, and the Division of Irrigation Investigations and Practice of the College of Agriculture, University of California. They seek to determine the economic duty of water for alfalfa under the soil and climatic conditions of the San Joaquin Valley. Various blocks of a uniform stand of alfalfa are being subjected to a seasonal application of 12 inches, 18 inches, 24 inches, 30 inches, 36 inches, 48 inches, 60 inches and 72 inches per acre. No results from these various applications are as yet available. The differentiation in treatment started with the season of 1922.

It has been assumed that the economical duty of water for alfalfa in the San Joaquin Valley is thirty-six acre-inches per acre. This amount is being delivered to several plots in varying amounts and in varying numbers of applications, in an effort to determine the most economic seasonal distribution of this water.

### *Investigations in Southern California.*

The regular work conducted from Los Angeles headquarters and relating more particularly to southern California and the Colorado River was interrupted in 1921 by the assistance given in the preparation of the irrigation map of California and again, to some extent, in 1922 by the aid given the State Water Resources Investigation. These, together with continued demand by the public for technical advice on irrigation problems, has delayed the publication of reports on several subjects for which the field work has been completed; namely the silt problem of Colorado River and Imperial Valley, the Cost of Water under Southern California Irrigation Systems and the Organization and Operation of Mutual Water Companies. Whereas, at one time the inquiries received pertained largely to such matters as irrigation practice and water rights, more recently there has been a greater proportion of those pertaining to irrigation organization, and the reclamation problems of the Colorado River.

Further irrigation development in southern California must depend principally on the storage of flood water. The normal flow of the streams is already appropriated and the draft on the underground waters has apparently about equalled the supply in most of the valleys. The great danger is in overdeveloping the underground supplies for there is no law to govern the matter and it is not easy to determine when an underground supply is fully appropriated until it is too late to forestall an overdraft. The spreading of water, although of certain value in stabilizing the underground basins, can not be regarded as a means to enable any large increase of the area irrigated. In answer to an inquiry this department recently prepared an estimate showing that about 70 per cent of the land irrigated in the coastal region is dependent on water pumped from wells.

Outside of San Diego County good reservoir sites are not found in abundance on the large streams where water now wastes to the ocean

in winter but the time has arrived when sites, although not economically feasible at an earlier period, can be reconsidered for the reason that the demand for, and value of water has increased, and the cost of storage may now in some cases be in part charged to power development and flood control. The reservoirs being constructed by Los Angeles County for the purpose of flood control are not expected to be great aids to irrigation because when filled they must be emptied to catch the next floods so they can not well be used to hold water for the irrigation season. This need not be the case with other reservoirs constructed primarily for irrigation and power and with flood control as a secondary purpose.

It has become necessary for this department to give some attention to drainage conditions in southern California. Inquiries received indicate that some erroneous ideas prevail as to the causes of the excess moisture in some of the lands that have been drained or that need drainage in the coastal region. It has been taken for granted that the moisture is the result of irrigation. Practically no land and none of that which has been drained has been damaged by irrigation. The lands, moist originally, have been dried up and made suitable for profitable tillage by pumping down the water levels for irrigation. This general result, differing from that commonly found in the irrigated valleys of the west, would probably not occur were it not that so much of the water used in irrigation is pumped from the underground and applied to crops under a high duty. Fears are expressed that drainage may become necessary in San Fernando Valley as a result of the irrigation under the Los Angeles aqueduct. This valley is closed to both surface and underground water except for its one main narrow outlet through which flows Los Angeles River. Nearly all of the 100,000 acres of the basin are now irrigated and owing to restrictions put on pumping by the city of Los Angeles under authority of a legally sustained Pueblo water right the underground water may not be held down as it has been in other valleys. In such case water logging might be avoided by allowing more pumping as well as by draining the wet surface stratum.

The chief moist areas are of 10,000 to 40,000 acres in extent and they are located near the coast in Ventura, Los Angeles and Orange counties. Smaller moist areas generally not exceeding 6,000 acres are found in the lower portions of San Bernardino, San Gabriel and San Jacinto valleys and on Chino Creek and on Santa Ana River near Arlington and Corona. In nearly all of these areas numerous flowing wells have been obtained. Considerable portions of all the larger areas have been drained by underground tile and open ditch systems installed by drainage districts and private parties. Coachella and Antelope valleys both situated on the inland side of the coast range contain moist and flowing well areas in their lower levels and in both, the effect of pumping for irrigation on the higher levels has had, as in the coast valleys, the effect of contracting instead of expanding the areas of moist land.

Drainage may become necessary in portions of all of the large Colorado River valleys. The Imperial Irrigation District is now proceeding with the preliminary work for the drainage of portions of its territory under a bond issue of \$2,500,000 for the purpose.



The plans now being formulated for further work from Los Angeles headquarters include the enlargement of the investigation on the cost of irrigation water to embrace all of the representative water companies and irrigation districts in the state. This course has been deemed advisable in response to an indicated wide demand for information on the subject.

**FINANCIAL STATEMENT**  
**COOPERATIVE IRRIGATION INVESTIGATIONS IN CALIFORNIA.**

	Expenditures			
	1920-1921		1921-1922	
	State	Government	State	Government
Irrigation map .....	\$6,414 75	\$7,968 28	\$8,725 40	-----
Delhi experimental tract .....	3,018 32	79 38	1,663 43	-----
Silt and cost of water .....	1,219 77	5,807 63	449 12	5,730 69
Investigation of irrigation enterprises .....	1,941 12	1,140 30	1,900 79	1,601 76
Miscellaneous office .....	1,614 50	2,157 18	2,675 09	1,056 43
Unexpended balance .....	388 09	-----	96 26	-----
<b>Total .....</b>	<b>\$15,494 55</b>	<b>\$17,152 77</b>	<b>\$15,510 00</b>	<b>\$8,397 95</b>

**IRRIGATION OF SHASTA VALLEY.**

Cooperative Investigation with the United States Reclamation Service and Klamath-Shasta Valley Irrigation District.

The Shasta Valley, which is located in the extreme northern part of California, pours its drainage into the Klamath River about mid-way along the river's course to the Pacific Ocean. This valley, situated at an elevation of about 2000 feet above sea level, is the largest body of agricultural land in the extreme northern part of the state. It contains 164,000 acres of agricultural land well fitted for dairying purposes and raising stock feed to supplement the grazing lands of the surrounding mountains. The rainfall in this valley is about 12 inches per annum and falls almost entirely in the winter season, so that without irrigation stock feed can be raised only in the spring months.

The Klamath Shasta Valley Irrigation District was organized under the Wright Act in 1921 and includes 125,000 acres of this valley. It does not include land already under irrigation, approximately 43,000 acres.

The 1921 legislature appropriated \$20,000 of state money to be used with a sum double this amount to be furnished by the Irrigation District and \$5,000 from the United States Reclamation Service, for an engineering investigation of the project. Accordingly, a contract was executed in October, 1921, between the three parties for the advancement of the investigations as provided by the legislative enactment. The first work undertaken was the mapping of the irrigable area on a scale of 2,000 feet to the inch, with 5 foot contour intervals. This work was completed by the topographers of the U. S. Geological Survey in September, 1922.

A survey of the main canal diversion from the Klamath River, the source of the water supply, by the engineers of the U. S. Reclamation Service, has also been completed. The proposed main canal heads at



Keno on the Klamath River and is 62 miles in length to the Little Shasta River.

A study of the irrigable area for design of distribution and drainage system is now in progress and should be completed at an early date. Reclamation Service engineers are also making a determination of the available unappropriated water and the best plan of development to secure the greatest use of this water on the lands of the Klamath Shasta Irrigation District. The cost of this work to September 1, 1922, has been approximately \$28,000 for topographic service, \$6,600 for canal survey, and \$2,600 for engineering investigations, making a total of \$33,000.

Applications to use the waters of the Klamath River for developing power in California have been made to the Division of Water Rights by the Electro-Metals Company and H. L. Jackman, of San Francisco. These applications propose to develop 375,000 theoretical horsepower, requiring a maximum of 9000 second feet, a distance of 100 to 125 miles downstream from the confluence of the Shasta River with the Klamath. Should these applications be granted with priority over the applications of the Klamath Shasta Valley, the waters of the Klamath River would flow by the Shasta Valley to be used in power development of these applicants, and it would be illegal to divert them for the irrigation of the Shasta Valley.

The State Engineer or Chief of Division, under provisions of section 2a of the Wright Irrigation District Act, has requested that no action be taken on the applications of the Electro-Metals Company until a report on the feasibility of the Klamath-Shasta Project is completed. Section 2a places this power in the hands of the State Engineer to request deferred action on applications before the Division of Water Rights whenever such applications appear to interfere with future development of irrigation,—such deference of action for the period of investigation by the State Engineer's office.

#### **FUNCTIONS OF THE DIVISION OF ENGINEERING AND IRRIGATION.**

The Division of Engineering and Irrigation is directed by law, through its executive officer, the Chief of Division and State Engineer, to perform many functions relative to the organization and construction of works by irrigation, reclamation and water storage districts, and in the development of the water resources of the state. Specifically, the principal functions are:

1. To investigate and report on feasibility of proposed irrigation districts.
2. To investigate and report on proposed bond issues by irrigation districts before the California Bond Certification Commission for approval.
3. To supervise expenditure of funds from approved bond issues and to inspect generally the construction work of irrigation districts.
4. To collect data, make surveys and perfect plans for reclamation of Sacramento and San Joaquin Rivers in conjunction with work of State Reclamation Board and to advise and assist the Board.

5. To investigate feasibility of water storage districts, the fixing of their boundaries and passing on their organization.

6. To pass on plans and specifications for construction of dams by other than municipalities or public utilities and inspect their construction.

7. To pass on plans for bridges across navigable streams.

8. To plan and construct works for rectification of river channels and protection of property from flood damage on the rivers of the state.

9. To direct cooperative stream-gaging, topographic surveying and irrigation investigations in cooperation with the Federal Government.

10. To direct cooperative work with the Federal Government in restraining debris on the Yuba River.

Along with these many permanent statutory duties which continue through succeeding years, the State Engineer is enjoined by legislative enactments to make special engineering investigations concerning the water resources of the state and to serve on special state commissions.

### EXPENDITURES FOR BIENNIAL PERIOD 1920-1922.

Expenditures by Division of Engineering and Irrigation, July 29, 1921 to June 30, 1922.

Chapter	Name of appropriation	Balance July 29, 1921	Expended	Balance June 30, 1922
419-1921	Rectifying river channels.....	\$175,000 00	\$61,796 79	\$113,203 21
889-1921	Investigation of state waters (3).....	200,000 00	89,716 72	110,283 28
704-1909	Gaging streams (2).....	12,579 34	11,467 56	1,111 78
704-1909	Irrigation investigation (2).....	7,374 84	7,374 84	
704-1909	Topographical surveys (2).....	14,500 12	13,928 62	571 50
754-1921	Shasta Valley irrigation investigation.....	20,000 00	5,036 91	14,963 09
469-1919	Rectifying river channels (1).....	30,885 39	8,968 68	21,916 71
526-1911	Mad River bank protection (2).....	1,776 79	1,731 90	44 89
14-1901	Restraining debris (2).....	20,174 76	11,861 43	8,313 33
645-1919	Contingent, seventy-second fiscal year.....	638 32	536 76	101 56
905-1921	Contingent, seventy-third fiscal year (4).....	6,464 03	6,051 47	412 56
905-1921	Salaries (July, 1921).....	3,968 67	3,968 67	
905-1921	Salaries, seventy-third fiscal year.....	15,435 75	15,052 09	383 66
905-1921	Printing, seventy-third fiscal year.....	1,000 00	474 90	525 10
905-1921	Salaries, seventy-fourth fiscal year.....	16,504 00		16,504 00
905-1921	Contingent, seventh-fourth fiscal year.....	5,000 00		5,000 00
905-1921	Printing, seventy-fourth fiscal year.....	500 00		500 00
324-1921	Cooperative river work (restraining debris).....	30,000 00		30,000 00
	Totals .....	\$561,802 01	\$237,967 34	\$323,834 67

Expenditures by Department of Engineering, Bureau of Engineering and Irrigation,  
June 30, 1920 to July 29, 1921.

Chapter	Name of appropriation	Balance June 30, 1920 and appropriations	Expended	Balance July 29, 1921
469-1919	Rectifying river channels.....	\$120,212 41	\$89,327 02	\$30,885 39
25-1911	Sacramento River flood control.....	29 86		29 86
503-1909	Humboldt Bay survey.....	499 46		499 46
526-1911	Mad River bank protection.....	3,045 92	1,269 13	1,776 79
14-1901	Restraining debris.....	40,968 41	20,794 15	20,174 76
742-1911	Canals and canalization of rivers.....	3 47		3 47
502-1911	Eel River bank protection.....	50		50
645-1919	Contingent, seventy-first fiscal year (\$2,258.00).....			
645-1919	Contingent, seventy-second fiscal year (\$20,000.00).....	22,258 00	21,619 68	1,638 32
905-1921	Contingent, seventy-third fiscal year (month of July, 1921).....	2,083 34	202 64	1,880 70
905-1921	Salaries (July, 1921).....	3,968 67		3,968 67
	Totals .....	\$193,070 54	\$133,212 62	\$59,857 92









# LEGEND

- Agriculture
- ▲ Power
- Mining
- ★ Municipal

Note.—Only live applications are shown. Up to September 1 1922 a total of 1150 have been filed with the Division of Water. Commission Act was passed in 1914. cancelled and 1150 have been given cancelled applications from the total 1150. Each one of these is shown by a star designating the use for which application is an approximate reproduction of a map in the office of the Division of Water. 12' x 15' and drawn on a scale of 4 miles to an inch.

STATE OF CALIFORNIA  
DIVISION OF PUBLIC WORKS  
DIVISION OF WATER RIGHTS  
MAP SHOWING LOCATION OF  
APPLICATIONS FOR WATER  
RIGHTS AND  
DIVISION OF WATER RIGHTS  
BOY





STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS  
DIVISION OF WATER RIGHTS  
KEY MAP SHOWING LOCATION OF  
APPLICATIONS FOR WATER  
BEFORE THE  
DIVISION OF WATER RIGHTS  
1922

LEGEND

- Agricultural
- ▲ Power
- Mining
- ★ Municipal

Note.—Only live applications are shown.

Up to September 1 1922 a total of 3003 applications have been filed with the Division of Water Rights since the Water Commission Act was passed in 1914. Of these 927 have been cancelled and 1150 have been given permits. Subtracting the cancelled applications from the total leaves 2076 live applications. Each one of these is shown by an appropriate symbol designating the use for which application is made. This sheet is an approximate reproduction of a large key map of California in the office of the Division of Water Rights measuring 12' x 15' and drawn on a scale of 4 miles to one inch.





THE  
DIVISION  
OF  
THE  
STATE  
OF  
CALIFORNIA  
IN  
COUNTIES  
AND  
CITIES

LEGEND  
 \* Agricultural  
 ▲ Power  
 ■ Mining  
 ★ Municipal

THE  
DIVISION  
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THE  
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CALIFORNIA  
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AND  
CITIES



PART IV

REPORT

OF THE

Division of Water Rights

A SUBDIVISION OF THE

DEPARTMENT OF PUBLIC WORKS

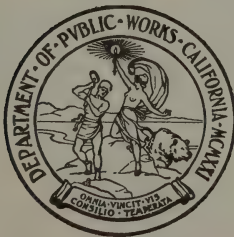
OF THE

STATE OF CALIFORNIA

*To Accompany the First Biennial Report  
of that Department*

NOVEMBER 1, 1922

H. A. KLUEGEL, Chief of Division



CALIFORNIA STATE PRINTING OFFICE  
FRANK J. SMITH, Superintendent  
SACRAMENTO, 1923

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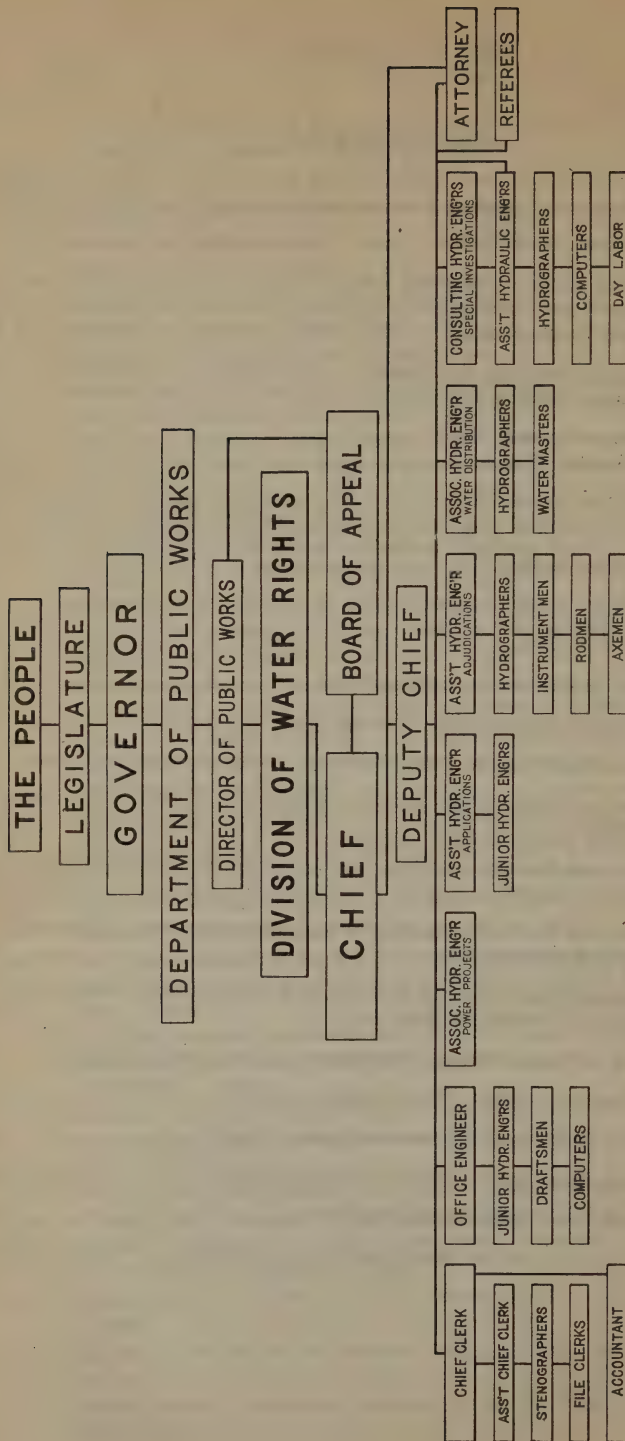
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# ORGANIZATION 1922

PLATE 1.

# REPORT OF DIVISION OF WATER RIGHTS OF STATE DEPARTMENT OF PUBLIC WORKS.

NOVEMBER 1, 1922.

## CHAPTER I.

### INTRODUCTION.

The Department of Public Works was created by an act of the 1921 legislature, which became effective July 29th of that year. By the terms of this statute the State Water Commission, as such, was abolished and its functions and duties under the Water Commission Act became the functions and duties of one of the divisions of the new Department of Public Works, namely, the Division of Water Rights.

This report concerns the activities of the office since the last biennial report of the State Water Commission, and covers the period from September 1, 1920, to September 1, 1922. During the first part of this time the work was carried forward under the supervision of the Water Commission, and during the second part under the supervision of the Chief of Division of Water Rights, who in turn is responsible to the Director of Public Works. This change in name has caused some difficulty in writing the report because reference is made continuously to the Commission or the Division as the case may be, and some confusion may be caused unless it is understood that the former refers to the organization prior to July 29, 1921, and the latter to the organization subsequent to that date. The office, however, functions under the definitions of and the authorities conferred by the Water Commission Act (chapter 586, Statutes 1913).

#### History.

The history of the Division of Water Rights and of the State Water Commission and the reasons for the establishment of the office go considerably farther back than the enactment of the Water Commission Act in 1913. Legislation along this line was proposed more than forty years ago, but it was not until about 1900 that the movement made much progress. There was an awakened desire for water supplies for irrigation about this time, influenced probably by the occurrence of a cycle of dry years. The perplexing status of California water law, however, and its general inadequacy, recognizing as it did the two conflicting doctrines of prior appropriation and riparian right, was a bar to progress, and there grew up an insistent and increasing demand for a water code under which development could proceed. A code similar to those adopted by other western states, and which had been exceptionally successful, was proposed, and soon after 1900 an attempt was made to have such a law enacted. There was determined opposition to such change, however, by the holders of vested water rights, particularly by riparian owners, and the movement failed. This situation was peculiar to California, as the other western states do not recognize riparian rights to a material degree.

The demand continued, however, and in 1913, due to the efforts of several earlier boards and commissions, the present Water Commission



Act was adopted by the legislature, and after being held up by referendum, was passed by vote of the people at the general election in 1914, and became effective December 19th of that year. The Commission was immediately organized, and it and its successor, the Division of Water Rights, have functioned as described in the succeeding chapters of this report. The office was at first maintained in San Francisco. However, early in 1922 it was moved to Sacramento and is now located in the Forum building in that city, where are also the several other divisions of the Department of Public Works.

#### **Purpose of Law.**

The true purpose of the Water Commission Act is to provide the legal machinery by which new vested rights to the use of water may be acquired, while at the same time rights which have already vested by use may be protected in their use of water. All new rights by appropriation must be acquired through the procedure required by the act and hence, through the supervision exercised by the Division of Water Rights, a complete record, valuable to both the state and the applicant, of the progress from the time of filing until use of the water is made is available, and when question arises there is little difficulty in finding from the record exactly what has been done. Chapter II gives a fairly complete description of the functioning of the office in recording these applications.

Rights which had vested prior to the Act are not so easily ascertainable, for there is no such record. Information as to these rights is continually sought by the Division by asking their owners to place their claims on record when a new appropriator on any stream applies to the Division. By means of the protests and supporting data filed in this connection, a great deal of information is being acquired and recorded as to the older rights, but this is at best fragmentary. To remedy this lack of knowledge as to the older rights, it has been provided in the act that a body of water users may ask the Division of Water Rights to survey all the irrigated lands on a stream and measure the diversions and thus determine the facts as to what rights have vested. In addition, by means of testimony and whatever records are available, the Division determines the date when such diversions were first made, and thus establishes their relative priorities. When such information has been completely gathered, the court may enter a decree affirming or modifying the same, and the whole proceeding then constitutes what is called an adjudication of these rights.

By this method the facts as to rights which have been acquired prior to the act are gathered as fully as is possible and after such a survey a complete record exists of all rights on the stream, both old and new. Although authorized to make such determination of old rights on its own initiation, the Division and its predecessor, the Commission, have never exercised such authority. However, on petition of the water users, it has thus determined, or is in process of determining, the rights on four streams involving 182,000 acres of irrigated land. Similar determinations have been made, in a somewhat less formal manner, on five streams involving 7700 acres of irrigated land. This last is by court reference, whereby the court, when a case involving water rights is before it, may refer the determination of the facts to the Division of



**Water Rights.** A narrative of these adjudications and court references is given in Chapter III.

**Division a Fact Finding Body.**

It will be thus seen that the largest function of the Division of Water Rights is as a fact finding and recording body. For new appropriations it keeps a complete record of all pertinent matters leading up to the vestiture of a water right, both in the office and by field examination. For old rights it determines the facts by field investigation and testimony.

In any legal controversy over water it is most often the questions of fact which are in issue. Such questions are also in issue constantly before the Division of Water Rights. Whether or not the Division has any quasi-judicial function, it can, if it is in possession of the facts regarding conditions on a stream, make known these facts to the interested parties in the issue and the matter is then susceptible of compromise, and no fair solution is possible if the physical facts are unknown. The Division is authorized to make such investigations of conditions in a more informal way than either an adjudication or a court reference, and has been requested to do so in a number of cases with funds furnished by parties in interest. These various investigations are discussed in Chapters V, VII and VIII. The investigation which has been of greatest importance, and has accomplished the greatest result, has been on Kings River, discussed in Chapter VII.

**Kings River Investigation.**

The question of the amounts of water diverted by the numerous canals diverting from Kings River had been in controversy for many years. Before such controversy could be settled it was necessary to determine the facts in the matter. Such a determination could be made only by painstaking continuous records of the diversions which were being made. Such a record has been now in progress for five years and most of the matters formerly in controversy are no longer subjects of dispute.

A digression here may be pardonable. It would be impossible to over-emphasize the importance to the state of the progress toward amicable settlement of disputes which has been made by the Kings River interests because they have seen fit, in the manner noted, to remove from the domain of controversy the facts as to the amounts of water being diverted.

This has led to another important step. The waters of Kings River are being distributed by a watermaster in accordance with a schedule worked out from the information gathered in the investigation. This is an important step in advance, for, after all, the object of all water law is to provide adequate means so that the owner of a vested right may receive the water which belongs to that right with the minimum of effort on his part and with no fear by reason of adverse claimants.

**Distribution by Water Master.**

All records in the office of the Division of Water Rights are made for that end, all facts gathered in adjudications are also to that end, all facts gathered in any investigation are gathered for that purpose.

But gathering the facts alone does not always accomplish the result in times of water shortage. Water in streams continually changes its position, and to ensure that a requisite amount reaches the owner of a vested right the conditions, which change from day to day, must be constantly observed. Some one must be appointed to measure and record the flow and to adjust from day to day the headgates of the canals diverting from the stream. Such an appointee, with proper authority, has been found to be the most effective agency by which the owner of a vested right may be relieved of constant vigilance to secure his water. There have been few appointed in California, but in other states practically all streams are thus regulated. Experience in this and in other states is discussed in Chapter IV.

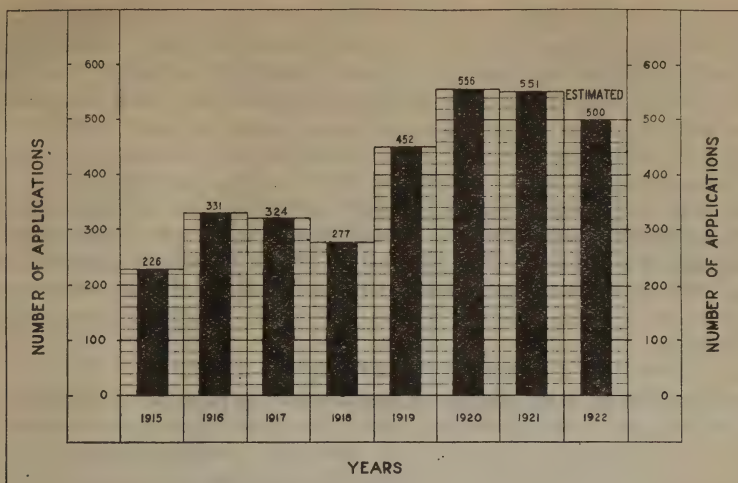
#### **Progress During Biennial Period.**

Speaking generally, the office has made material progress in all its more important functions during the two years just passed. At the beginning of this time the State Water Commission was many months behind in its work, due to the great and sudden increase in all lines of water resource development which came about following the close of the World War and the resumption of business activity in 1919. This rush of work found the Commission unprepared, both as to funds and personnel. Neither defect could be remedied on short notice, as additional funds were not available, and due to the legal and technical complexities of all activities under California water law, very specialized experience is necessary in the engineering personnel. The organization has been built up to meet the situation as rapidly as possible, and more adequate funds became available at the beginning of the present biennium on July 1, 1921. At the present time, the Division is approaching the condition of being able to function rapidly and efficiently on the work coming before it, which will be a most gratifying change from the status obtaining since early in 1919. This statement can not be closed without grateful acknowledgment to the unfailingly loyal and hard-working employees of the Division who have made this result possible.

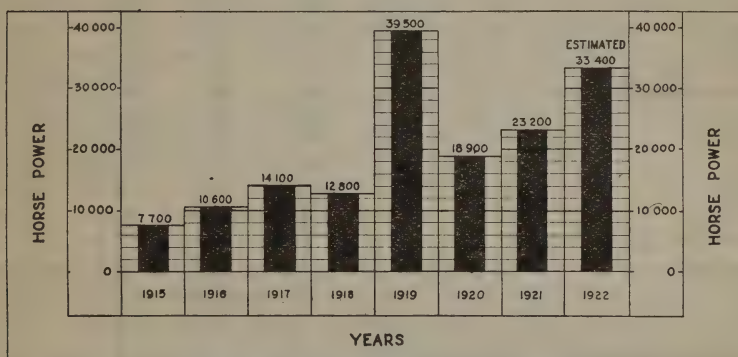
#### **Applications to Appropriate Water.**

In Table 1, page 12, is shown in comparative form a summary of applications received and permits issued during each biennial period since the act was passed. Also, on Plate 2, page 11, is shown graphically the number of applications as compared to size. It will be seen that there is a constant increase in both size and number of applications. This increase can not, of course, continue and there is some indication from the graph that the number of applications per year will not further increase. It would seem reasonable to expect that the size of development proposed in each application for irrigation use would continue to increase, for the smaller projects have presumably been well taken up, and future developments must necessarily be in larger units. This increased complexity has been reflected already in the increased investigative work done by the Division.

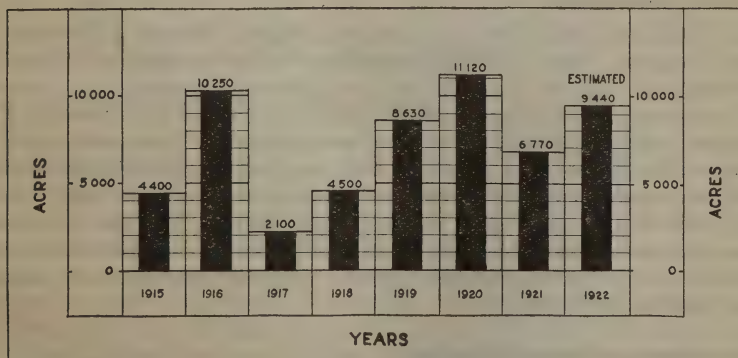
The succeeding chapter contains a series of graphs depicting the activity in various phases of such work since the establishment of the



TOTAL APPLICATIONS RECEIVED



HORSEPOWER PER APPLICATION



ACRES PER APPLICATION



office, one of which shows the number of unacted upon or pending applications to appropriate water for each quarterly period. Since January, 1922, and for the first time in the history of the office, this number has not increased, showing that applications have been disposed of, by permit action or cancellation, at a rate equal to their receipt. The issuance of larger numbers of permits will cause a constant increase in field investigations and inspections, however, as the permits are kept under close supervision in order that there may be no lapse in that record of development which is necessary to finally vest these rights.

Chapter II is devoted to a discussion of the functions and activities of the Division in the supervision of the acquisition of new water rights, and reference to this chapter is made for more detailed information on this subject.

TABLE No. 1.

Numerical Summary by Biennial Periods of Applications Received and Permits and Licenses Issued.

	Totals to Dec. 1, 1916	Dec. 1, 1916 to Sept. 1, 1918	Sept. 1, 1918 to Sept. 1, 1920	Sept. 1, 1920 to Sept. 1, 1922	Totals
<b>Applications Received</b> .....	<b>524</b>	<b>531</b>	<b>925</b>	<b>1,023</b>	<b>3,003</b>
Agricultural.....	429	380	658	577	2,044
Power.....	33	61	164	267	525
Mining.....	48	73	60	79	260
Municipal.....	8	6	16	23	53
Domestic.....	6	11	27	77	121
Applications closed.....	85	153	314	330	882
Applications pending—end of period.....	231	349	694	1,003	1,003
<b>Permits issued</b> .....	<b>208</b>	<b>259</b>	<b>267</b>	<b>384</b>	<b>1,118</b>
Agricultural.....	173	199	199	273	844
Power.....	9	14	23	45	91
Mining.....	22	37	34	29	122
Municipal.....	0	1	2	5	8
Domestic.....	4	8	9	32	53
Permits revoked.....	5	32	53	134	224
Permits pending—end of period.....	203	395	554	746	746
<b>Licenses issued</b> .....	<b>1</b>	<b>36</b>	<b>55</b>	<b>58</b>	<b>150</b>
Agricultural.....	0	23	33	30	86
Power.....	1	2	8	8	19
Mining.....	0	5	7	14	26
Municipal.....	0	0	0	0	0
Domestic.....	0	6	7	6	19
Licenses revoked—end of period.....	0	0	0	1	1

#### Summary by Counties.

In Tables 2-A and 2-B, appearing on pages 16 and 17, at the end of this chapter, will be found summaries of the present and proposed irrigation and power development in California, separated by counties. The summary of existing development is not from the records of the Division, but is of interest by way of comparison. These tables give the number of applications received, the number of permits issued, the acreages planned to be irrigated and horsepower planned to be developed both for permits and pending applications. While the figures appear excessive, and do contain some duplications which could not be eliminated, they still represent actually proposed development, some of which will be put through.

#### Adjudications and Court References.

The accomplishments of the Division in the determination of rights by adjudication or by court reference proceedings during the biennium



are fully set forth in Chapter III. This important part of the work has increased considerably; however, in view of the great value to vested rights in receiving a clear and easily defended definition of such rights, it is the belief of the Division that this phase of its service is yet in its infancy.

#### **Administration.**

The legislature in 1921 amended the Water Commission Act to provide for effective state administration of the distribution of water in accordance with rights which had been adjudicated. Activity under this amendment is recited in Chapter IV.

#### **Special Investigations.**

In Chapter V is given a résumé of a number of water resource investigations which are being carried on under the direction of the Division. One of the more important of these, that on Kings River, has already been commented upon. Another, on the San Joaquin River, equally important in the development of the state, is treated fully in Chapter VIII.

These investigations, while desired by the Division in connection with action upon applications, have required field work and studies too expensive for the office to undertake, and the applicants, or interested parties, have advanced part or all of the funds with which to prosecute the work.

During the past year the Division has supervised the expenditure of approximately \$35,000 in this class of work and has contributed directly from state funds somewhat less than \$4000.

A considerable demand exists for the direction by a disinterested agency of such investigations in various parts of the state. The determination of obscure physical facts must be made by experienced and competent engineers; also, the results to be of full value and acceptable to all local interests must be entirely impartial. Particularly is this true of underground water investigations. The Division of Water Rights, as an impartial fact finding body with specialized experience along these lines, is singularly well fitted to render this assistance, and it is believed that this is a proper field for state cooperation and participation: first, because of the areas, people and investments involved, and secondly, because it is felt that state encouragement should be given to further development of its natural resources.

#### **Cooperation with United States Departments.**

The Division maintains close and effective cooperation with the United States Forest Service, Geological Survey, and Power Commission. This cooperation is not only mutually advantageous, but on account of the relation of the National Government to the state, the one controlling all lands unpatented, the other all water unused, is necessary for proper operation of the offices concerned, and to be able to give the service to which the public is entitled. For instance, if the Division of Water Rights and the Power Commission did not function in unison, power projects in this state might be held up for years or be defeated altogether. The Forest Service is of particular assistance to the Division in inspecting small outlying diversions, very difficult

and expensive to get at otherwise. The water resources branch of the Geological Survey collects stream flow records throughout the state, which records, in view of the already large use of water, are necessary before any project, irrigation or power, can proceed intelligently, and which are therefore vital to the development of the state. The Division of Water Rights contributes financially to the collection of these records. A full description of all activities in connection with the federal departments is given in Chapter VI.

#### **Record of Old Rights.**

During its eight years of existence the office has received in connection with applications and protests and in other ways a large amount of data relative to vested water rights established prior to that time. These data are filed in the office of the Division as public records, and there is a considerable use made of them by the public. There is also a demand for such records not on file with the Division, as it is naturally supposed that the office has a complete record of established water rights. The Division believes that ultimately such a record should be in the office, both for its own use and for that of the public, and is gradually assembling in available form such data as is received.

#### **Economy of Placing Rights on Record.**

The value to the owner of an old water right of having a record of the same on file in the Division office is brought out elsewhere in this report. However, it is noted that it is especially valuable to the large company or holder of many rights, as in addition to the protection feature, the expense and annoyance of protest correspondence, etc., is reduced.

#### **Bureau of Information.**

The Division acts in the nature of a bureau of information in answering questions regarding water right principles. In this, it has been of much service in settling difficulties, in clearing up a number of intricate water tangles, and in bringing together those who desired an equitable settlement of their difficulties, but were in doubt as how best to proceed. It is believed that much useless and expensive litigation has been avoided through this service.

#### **Tulare Decision.**

In December, 1921, the Supreme Court of California handed down a decision in the so-called "Tulare Case." An action had been initiated in 1919 by the Tulare Water Company, a subsidiary of Miller and Lux, to compel the Water Commission to issue a permit on its application for water from Buena Vista Slough, the Commission having denied the application. The Commission had then entered a demurrer to the prayer for writ of mandate and the case on demurrer had been taken to the Supreme Court.

Probably no California decision in recent years has received more local publicity and certainly no decision has been more universally misunderstood. Primarily on this account a full statement of this case has been made in Chapter IX by Mr. Spencer E. Burroughs, attorney for the Division, in connection with a description of the work of the legal department.

### **Riparian Rights.**

The familiar subject of riparian rights can not be passed without mention. This is written merely to emphasize the fact that the problem of unused riparian rights has not been solved, but is still with us, and to point out that a vast number of such unused rights are in existence. Since 1911 no less than seven investigative or regulative state boards or commissions have been formed by the legislature (including the Division of Water Rights) to promote the development of the state's water resources, and all have encountered the bar of the riparian problem immediately. A great deal of thought has been given the subject by these boards and their recommendations vary from condemnation to laws designed "to lessen the riparian right evil."

The attitude of the state was crystallized in a law set forth in section 11 of the Water Commission Act, which provides that riparian rights not exercised within ten years after the passage of the act (Dec. 19, 1914,) shall be forfeited. If this law proves an equitable method of dealing with the matter, the great problem will be practically solved, and a serious bar to California's progress removed.

### **Los Angeles Office.**

There has been a growing demand during the period of increasing activity in water development since the close of the war, that the Division maintain a serviceable branch office at Los Angeles. Of the total of 3003 applications to appropriate water received, 1049 are in the ten southern counties which would be tributary to a Los Angeles office. The Division feels that in all fairness to the southern part of the state, such an office should be established.

### **Underground Water Problems.**

Southern California has also within recent years developed a series of physical and legal problems in connection with the use of underground waters which are not covered by either court or statute law, and which are becoming of a serious nature. This situation is discussed in Chapter X and recommendations for legislation to clarify the situation are advanced.

### **Minor Amendments to Water Law.**

The Water Commission Act as enacted in 1914 has been successively amended by the legislature in the 1917, 1919 and 1921 sessions. With the advances being made in the character of development work, new problems continually arise not contemplated by the original act, and amendments, usually of a minor nature, become necessary. A number of such minor corrections and amendments, the need for which has developed, will be submitted to the next legislative session.

## **RECOMMENDATIONS.**

In closing this chapter, the Division of Water Rights advances the following recommendations relative to legislation:

First: Amendment to the Water Commission Act providing limited jurisdiction over underground water, and making certain definitions with regard to the same.



Second: Minor amendments in connection with the act for which need has developed.

Third: Appropriation of sufficient funds to allow the Division to fulfil its proper place in the development of the state water resources.

TABLE 2-A.

Summary by Counties of Development as Proposed in Applications Received.

County	Applica- cations received	Projects under permit or license			Applications pending		
		Number	Acres	Theo. H. P.	Number	Acres	Theo. H. P.
Alameda.....	3	1	1				
Alpine.....	13	3	605	2,500	6	41,000	64,000
Amador.....	36	2	10		26	62,000	280,000
Butte.....	113	25	35,375	3,732	50	*400,000	158,000
Calaveras.....	37	3	10	13,650	18	43,000	131,000
Colusa.....	48	22	130,658		12	*350,000	
Contra Costa.....	17	7	10,755		9	14,000	
Del Norte.....	19	4			2		
El Dorado.....	86	22	302	219,456	50	*50,000	300,000
Fresno.....	74	27	147,773	1,718,829	32	*950,000	470,000
Glenn.....	24	10	46,390		3	*250,000	
Humboldt.....	36	12	372	239	13	240	368,000
Imperial.....	22	12	5,269		1	12,000	
Inyo.....	187	51	10,986	6,985	42	*120,000	54,000
Kern.....	89	24	2,247	79,146	15	*500,000	1,260,000
Kings.....	9	2	8,391		3	*400,000	
Lake.....	19	9	259	8	1		
Lassen.....	73	22	5,498		15	*100,000	
Los Angeles.....	191	59	6,686	4,943	54	*80,000	5,000
Madera.....	25	1	15		15	350,000	729,000
Marin.....	3	1	1		1		
Mariposa.....	29	4	189,781	96,193	10		269,000
Mendocino.....	28	17	442	15,068	8	155	36,000
Merced.....	20	9	7,903		5	40,000	
Modoc.....	106	37	16,144		28	140,000	
Mono.....	134	29	8,202	17,008	37	*50,000	97,000
Monterey.....	18	8	141		1	54	
Napa.....	27	8	1,589		3	50,000	
Nevada.....	48	2	58		49	210,000	282,000
Orange.....	6	1			2	5	
Placer.....	73	17	736	79	32	*130,000	597,000
Plumas.....	75	15	262	7,263	30	7,100	305,000
Riverside.....	115	32	51,080	17,925	35	*100,000	84,000
Sacramento.....	23	11	29,457		10	*300,000	
San Benito.....	13	2	86		9	*100,000	7,000
San Bernardino.....	246	81	11,193	22,340	75	*50,000	52,000
San Diego.....	78	21	5,241	3,030	28	25,976	11,000
San Francisco.....							
San Joaquin.....	42	13	14,657		21	*320,000	
San Luis Obispo.....	15	3	23,050		8	300	1,000
San Mateo.....	6	2	167		1	730	
Santa Barbara.....	18	9	493		3	5,100	
Santa Clara.....	24	7	319		11	*150,000	
Santa Cruz.....	14	2	80		9	300	5
Shasta.....	79	28	41,982		15	4,000	254,000
Sierra.....	79	11	100	5	34	8,000	472,000
Siskiyou.....	105	48	45,007	73	22	70,000	60,000
Solano.....	16	2	97		10	220,000	
Sonoma.....	21	11	315		4	200	
Stanislaus.....	40	20	15,771		7	350,000	
Sutter.....	50	28	82,777		10	180,000	
Tehama.....	49	9	3,496	10,227	20	*350,000	116,000
Trinity.....	89	37	1,169	88	28	200	125,000
Tulare.....	31	5	90	1,640	13	70,000	137,000
Tuolumne.....	37	12	335	140	10		234,000
Ventura.....	52	13	670	10,000	16	30,000	72,000
Yolo.....	22	14	58,763		4	110,000	
Yuba.....	46	7	15,021		21	180,000	59,000
State of Nevada†.....	5				5		

\*Acreage applied for in counties marked thus is greatly in excess of the figure shown in table, but has been reduced to approximate the irrigable acreage in the county or the water supply available to the county.

†To be diverted in Nevada and used in California.



TABLE 2-B.

Summary by Counties of Present Development.

County	Developed water power		Present total acreage irrigated
	Number of plants	Installed horse-power	
Alameda			14,200
Alpine	1	400	4,800
Amador	1	37,500	200
Butte	5	147,200	98,200
Calaveras	3	4,000	100
Colusa			135,700
Contra Costa			67,300
Del Norte			
El Dorado	1	8,100	6,100
Fresno	4	177,500	600,400
Glenn			119,500
Humboldt			2,500
Imperial			463,900
Inyo	9	48,100	70,700
Kern	4	119,600	321,100
Kings			445,000
Lake			1,400
Lassen	2	5,800	62,300
Los Angeles	8	95,400	307,300
Madera	5	35,500	136,300
Marin			300
Mariposa	5	5,100	
Mendocino	2	16,100	2,500
Merced	1	800	388,500
Modoc	1	500	121,000
Mono	5	22,500	59,500
Monterey			72,000
Napa			2,500
Nevada	11	20,600	4,400
Orange			149,600
Placer	7	82,000	36,000
Plumas	7	64,600	33,900
Riverside			173,100
Sacramento	2	4,800	130,400
San Benito			23,300
San Bernardino	8	17,200	126,800
San Diego	2	900	42,300
San Francisco			400
San Joaquin			304,000
San Luis Obispo			8,200
San Mateo			12,200
Santa Barbara			16,700
Santa Clara			95,400
Santa Cruz	2	1,600	1,700
Shasta	12	181,500	52,900
Sierra	3	600	13,900
Siskiyou	3	22,400	76,000
Solano			90,100
Sonoma	1	400	2,600
Stanislaus	1	1,700	244,300
Sutter			85,400
Tehama			49,500
Trinity	5	6,900	7,100
Tulare	5	24,900	515,400
Tuolumne	6	65,900	500
Ventura			47,900
Yolo			124,900
Yuba	1	20,300	27,100

## CHAPTER II.

### SUPERVISION OF ACQUISITION OF NEW RIGHTS.

The Water Commission Act provides for state supervision over all water rights initiated after the date the act went into effect, or December 19, 1914, and in a measure also provides for supervision over rights of appropriation initiated prior to, but not yet perfected at that time.

This is in contrast to the conditions which prevailed previously when there was in California no state supervision over the acquisition of new rights to the use of water. Appropriative rights could then be acquired either under the provisions of section 1415 of the Civil Code by posting a notice of appropriation at the proposed point of diversion, recording a copy of such notice in the office of the county recorder and proceeding with "due diligence" to construct the necessary works and to apply the water to beneficial use,—in which case priority ran from the date of posting the notice,—or a water right might be acquired by merely constructing the necessary works and applying the water to beneficial use, in which case priority ran from the date on which the water was actually beneficially used.

There was during this time no attempt to define the project for which the appropriation was made. The amount claimed was generally out of all proportion to what would be required under conditions of reasonable use. There was no means to work out the relation of the new appropriation to vested rights or future appropriations except by tedious and expensive litigation. There was no definite requirement in the way of diligence. And there was no adequate means of eliminating the "dead timber" of rights once initiated but forfeited through non-use.

An analysis of the nature of the supervision over the acquisition of new water rights provided for in the Water Commission Act, and now exercised by the Division of Water Rights, follows: There is also included a statement of the office and field procedure by which this supervision is carried on and some statistical summaries and diagrams showing the activities of the Division.

#### Character of Supervision.

The principal service performed at present by the office of the Division of Water Rights is in connection with the initiation of new rights through applications filed to appropriate water under the provisions of section 11 of the Water Commission Act. This service is performed by the functioning of the office in four ways:

The first, and perhaps most obvious of these functions, is the service which is performed in acting as a central recording office for all new water rights initiated within the state. The files of the Division of Water Rights now contain a complete list of all appropriative rights to the use of water initiated since the approval of the Water Commission Act, and reference to a single map shows at a glance not only the location of each diversion point but the status of the right, *i.e.*, whether only initiated, approved for permit, or construction completed and use confirmed by issuance of license.

This is a marked improvement over conditions obtaining previous to the approval of the act when it was a very difficult matter for one con-

templating a new appropriation to determine how the flow of the stream from which he proposed to divert might be affected by vested rights, and more especially by those recently initiated.

The second, and probably most important function at the present time in connection with applications filed under section 11 of the act, is the clear definition which is worked out for each right initiated.

Before the application is approved for permit, the applicant must make known upon his application form and the accompanying maps, the source of the proposed appropriation, the location of the point or points of diversion, the character and capacity of the proposed diversion works, the location and character of the proposed use and all other data necessary to adequately describe his project.

The third function in connection with applications under section 11, is the service which is performed for the applicant and for owners of vested rights in working out the probable extent of interference of the proposed diversion with diversions under vested rights.

This service is performed by first giving proper publicity to the proposed appropriation, then hearing and investigating protests filed, and lastly, if in order, approving the application for permit with such limiting clauses "as in the judgment of the Commission will best develop, conserve, and utilize in the public interest the water sought to be appropriated."

Under conditions prevailing prior to the passage of the Water Commission Act, there were no adequate means by which a new appropriator might determine the nature and extent of opposition by vested rights.

The Division now endeavors to advise all parties who may be interested in a new appropriation and proceeds to make clear the relation which the proposed new appropriation will have to diversions under vested rights. This relationship is brought out by correspondence, by conference, and by investigations both in the field and office. All interested parties are requested to furnish any data which are pertinent. If there is no unappropriated water the fact is clearly presented to the applicant. If there is unappropriated water, available to the applicant, without interference with use under vested rights, that fact also becomes clear. In such case, without resort to litigation, the conditions are defined under which this unappropriated water may be diverted by the applicant.

Owners of vested rights should recognize that a well sustained protest wherein the nature and extent of the rights involved are clearly defined accomplishes for a protestant much the same result by reason of this definition, as an application filed by a new appropriator, in that it tends to establish the relation of the one right to others, both old and new, upon the same stream, and this at a time prior to the commencement of construction in connection with the new appropriation.

The fourth valuable function performed by the Division in connection with applications filed under section 11 is the clearing away of "dead timber." This is brought about by weeding out impractical, visionary, and speculative projects and by promptly scaling down to reasonable amounts the quantities applied for.

The completion of an application with proper accompanying maps, the clearing away of protests and definite statement of plan, works no hardship upon the bona fide project. Every step required by the



Division is one which the promoter of a project must in any event take in its orderly development. But the surveys, the preparation of maps, and the response to protestants does throw a burden upon the visionary, impractical and purely speculative projects which prevents them from standing indefinitely in the way of live projects.

At the earliest practical moment after receipt of an application the quantity of water applied for is scaled down to an amount consistent with the beneficial use in the project contemplated. Permits are refused for water in excess of such an amount, the period for construction is defined and time limit set for the initiation and completion of beneficial use.

With the wide seasonal variation of California streams there may be unappropriated water during one portion of the year and not at another. By inserting in the permit the approximate period of the year when there may be unappropriated water, and denying the application for the remainder of the year, one common cause of controversy, the attempted diversions by later priorities when the stream flow is low, is eliminated.

Annual progress reports are required from permittees and if construction and use is not completed within reasonable time the permit is either revoked or a license issued for the amount of water actually applied to beneficial use only.

Aside from the initiation of new rights of appropriation under section 11 of the Water Commission Act, the Division of Water Rights has various other functions in connection with the acquisition of other new rights. These are (1) the authority, under section 11 of the act, to declare that a group of diversions benefiting from a common storage development may be designated as one project and so considered; (2) the authority under section 12 of the act to prescribe conditions under which an applicant may join in the occupancy and use of existing works for the diversion of water or may enlarge existing works and thereafter share in the occupancy and use thereof; (3) the authority under section 12 of the act to prescribe for a particular project the time within which the full amount of water appropriated prior to the passage of the Water Commission Act shall be applied to a useful or beneficial purpose, providing reasonable diligence has been shown; and (4) the authority under section 16 of the act to consider and accept or reject, petitions of permittees and licensees to change points of diversion and use.

In numerous instances the Division has declared related reservoir projects a unit and established a construction program prescribing definite dates for completion of the various parts thereof, allowing a large project to have its priority maintained and protected during development, providing reasonable diligence is shown.

There has as yet been no request for the office to function in the matter of prescribing the conditions under which applicants may enlarge and share in the occupancy and use of existing works.

There have been filed altogether twenty-two petitions under section 12 of the act requesting that the Division issue a certificate prescribing the time within which the full amount of water appropriated according to the law prior to the passage of the Water Commission Act shall be applied to a useful or beneficial purpose.



The authority under section 16 of the act to consider and accept or reject petitions to change points of diversion and places of use under rights initiated by application to the office is one often invoked and is of considerable importance. Such changes are allowed provided no injury will result therefrom to vested rights. Prior to the passage of the act there was no prescribed way of bringing about such changes nor is there now any method provided by law for making such changes in rights other than those initiated by application to the Division.

The office also endeavors to maintain upon its records the chain of title to all rights initiated through its functioning and has adopted the practice of requiring all assignees of applications to file proper evidence of transfer.

To summarize, it may be said the character of supervision exercised by the Division of Water Rights over the acquisition of new appropriative rights is such as to define and maintain a public record of all rights initiated, establish the relation of rights so initiated to vested rights, and clear away the "dead timber" of rights initiated and forfeited through failure to complete or through non-use.

#### **Office Procedure in Connection with Supervision.**

The office procedure under which the above described supervision is carried on is the result of approximately eight years of development and has become well established.

When an application is received there are four simple requirements which must be satisfied before the application will be accepted and a priority established. The application must be accompanied by the five dollar filing fee required by law, it must give the source of the proposed appropriation, name an amount, and locate, at least approximately, the proposed point of diversion. When the new application is satisfactory in these four requirements it receives a number and is at once referred for examination as to remaining details and inspection of maps.

It is an unusual occurrence for an application to be received which is complete and accompanied by satisfactory maps. And although the requirements in this respect would appear fairly simple and void of all unnecessary intricacies, still it may be said that a very considerable portion of the work of the office is expended in an effort to obtain from applicants a clear and consistent definition of their intention and purpose in connection with projects described in the applications. The value of this effort has been explained heretofore. It is of sufficient importance to repeat that there is at the present time no more important function of the Division than that of working out a clear definition of all new appropriative rights to the use of water initiated in the state.

When an application has been completed in all details, and the necessary maps have been filed, steps are taken to give proper publicity. All other applicants before the Division on the same stream, all protestants to these previous applications, and all other individuals and corporations, of which the office, through its various channels of information, has been advised as being interested, are sent notices giving the essential data of the application. Copies are also sent to local postmasters for posting in a conspicuous place.

If the proposed diversion is for more than three cubic feet per second or two hundred acre-feet per annum, the notice is also published in a newspaper of general circulation within the stream system.

Protests are invited by this publicity and the protestant is required to serve a copy on the applicant. The applicant is required to reply thereto, also serving a copy on the protestant. After all protests and answers are in, and after all other data are gathered an analysis of the project is made. If the matter is not yet clear a field investigation is required. An effort is made to establish clearly to the applicant and also to the protestant the relation of the proposed new project to the claimants of vested rights or prior appropriative rights not yet vested. Ultimately, the Division is able to take final action with the reasons therefor clear to all. This final action may be the issuance of permit on the application as filed, or the issuance of permit on a modified application, or cancellation.

In connection with the publicity and protest procedure as described, in some instances companies or concerns having extensive or complicated vested water rights have filed with the Division a complete statement of their claims. As heretofore pointed out, the state, the protestant and applicant are all gainers by a valid protest, because it places on record, in a central clearing house, information which should be public. On practically all streams there are applicants before the Division and will be more, and so a statement of all claims on all streams relieves the large concern of the necessity for reiteration of protests in connection with each new application.

After the issuance of a permit there is little office activity in connection with the supervision of the initiation of new rights under section 11 of the act. Permittees may request extensions for completion of construction and use, they may request that there be entered upon the record assignments of the rights initiated or they may petition changes in the points of diversion and use, which latter matters are handled much in the same manner as the receipt of a new application in that the proposed changes must be clearly defined, proper publicity must be given, and protests must be received and considered. Eventually, as a result of the reports by permittee or of field inspections made by the field engineers of the Division each permit is either revoked or a license is issued thereon, certifying that as a result of construction and beneficial use under the terms of the permit the permittee is entitled to a right to the use of a certain amount of water under a priority of the date of his original application.

Applications filed under section 12 of the Water Commission Act requesting that the Division consider the matter of diligence shown in connection with the completion of appropriations begun prior to the passage of the act have been few in number and are handled in almost identically the same manner as applications filed under section 11 as heretofore described.

The remaining functions of the office in connection with supervision over the acquisition of other new rights comprise also a relatively small part of the work performed in the office and the procedure connected therewith is, therefore, passed without further discussion than that heretofore given in this chapter.

#### FIELD INVESTIGATIONS.

The field work carried on by the Division of Water Rights in connection with the supervision of the acquisition of new rights is divided into three classes: first, the investigation of applications and protests

thereto, prior to action relative to issuance or denial of permit; second, the inspection of construction work and use of water under permits issued; and, third, the investigation of miscellaneous matters pertaining indirectly to applications and permits.

About one-third of the applications received by the office are protested, and about one application out of every eight received requires an investigation in the field by an engineer.

Protests vary in nature and kind from those which are merely intended to place certain existing rights on record in connection with the proposed application, to those which require a very careful study of water supply, existing rights and other conditions, and involve conferences and hearings as well.

The field work in connection with a protested application may consist of merely a visit to the site of the controversy and an interview with interested parties, it may include a series of stream or ditch measurements extending over a period of from a few days to several years, together with studies of use under existing rights, or it may include the planning and supervising of an extensive study of water supply, including both surface and underground water. It is often advisable to hold conferences or hearings in the locality in question, in order to bring out all information possible bearing on the subject, and if necessary to effect a modification of the application, or an agreement between parties, in order that future controversy will be eliminated.

The Water Commission Act provides that the office shall cause an inspection to be made of the project under a permit after the date when the same has been completed in accordance with the law, terms of the permit, etc. Based upon the use as found by this inspection, a license is issued, or an extension of time is granted to complete use, if it appears that reasonable diligence has been shown. If such diligence has not been shown, the permit is revoked.

The construction work on larger projects is inspected from time to time for the purpose of obtaining a record of diligence in construction. In case it has been found that no work has been done, the permit is revoked and the applicant may make a new filing with a later priority if he so desires. This is a direct service to all later appropriators, inasmuch as it does not allow holders of permits under early priorities to maintain them without making a reasonable effort to utilize the water.

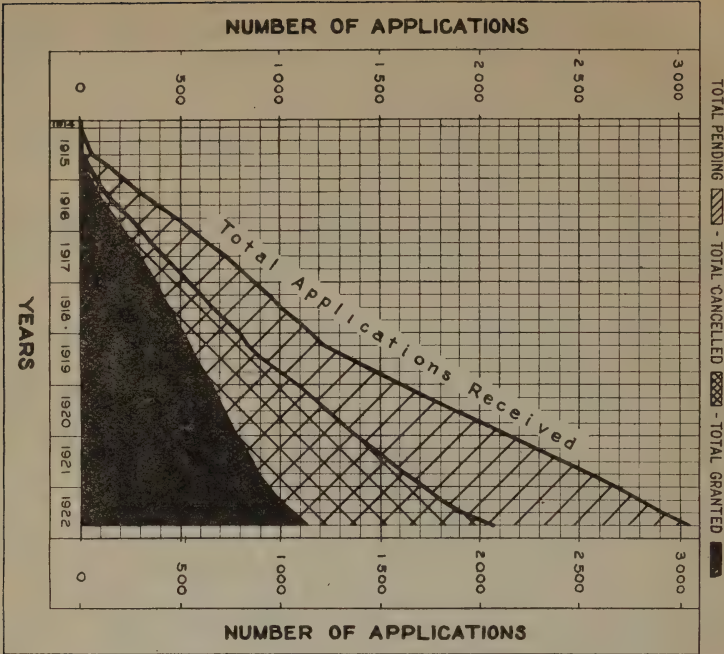
Where use of water has not been made, or is only partially completed by the date set, and it appears that with reasonable diligence the use should have been completed, the permit is revoked, or a license issued based upon the amount of water which has been put to beneficial use, and if the permittee desires to proceed with his development, a new priority is required to be established through a new filing.

Miscellaneous matters investigated in the field range from the collection of special hydrographic data pertaining to a particular time or locality, and necessary in connection with the work of the office, to assistance in general matters relating to water and within the jurisdiction of the Division. Some of these investigations are of sufficient importance that they are treated individually hereafter in Chapters V, VII and VIII. Power projects and the more complicated irrigation projects are requiring an increased amount of time, but the major portion of the field work is in connection with routine matters,

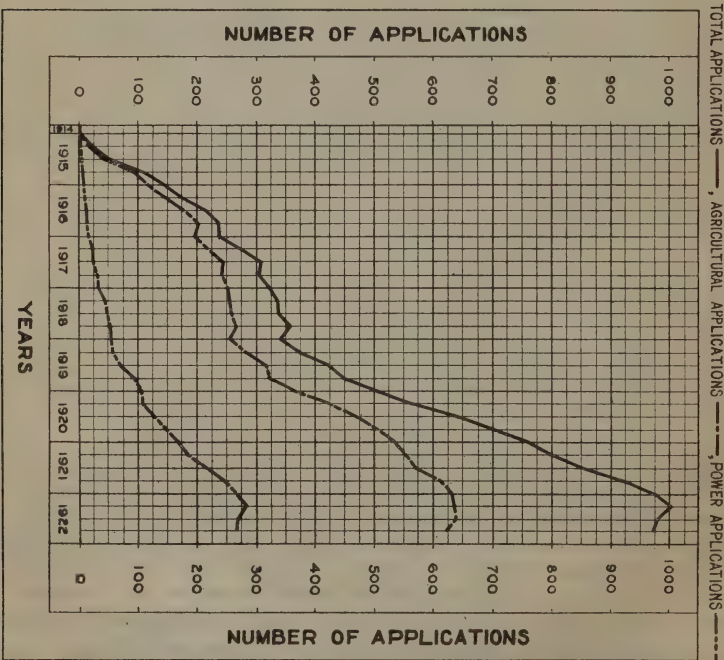


# GRAPHICAL SUMMARY OF APPLICATIONS

## ACTION ON APPLICATIONS



## APPLICATIONS PENDING





The field engineers, visiting every section of the state on these matters, become familiar with local conditions, and the knowledge they obtain is of great assistance in connection with matters which can not be clarified by the office through correspondence.

Due to the large number of cases which must be visited each year in the field, careful planning of the season's field work is necessary, in order that traveling expense and time can be kept at a minimum. This method of grouping cases to be visited according to locality and trip often causes delay in acting upon matters awaiting field investigation, but with the number of engineers available for the work at present, it is the only manner in which the work can be handled and the ground covered.

There are four engineers who devote the major part of their time to routine field inspections and investigations and reports thereon. During the biennium there were 1334 cases requiring field investigation, but of these it was possible with the force available to visit only 984. Due to greater familiarity with the state and with local conditions, there is an increasing efficiency in handling this work.

There is a considerable lag between the time an application is received and the time when field work becomes necessary upon it. Many applications require two or three visits in one year, and visits extending over several years before they are settled. Most permits require more than one visit before license is issued, due to extension of time allowed. The increase in field work required in 1922 over 1921 reflects the increase in number of applications received during 1920 and 1921 over preceding years. During the next year or two this work will probably at least stay constant, if not increase in amount. An increased number of permits due for inspection can be expected during the succeeding years, as they do not usually require inspection for from two to four years after the applications are received. Of those considered for inspection during 1922, only 5 per cent were upon applications received during 1921, 24 per cent upon applications received during 1920, and the remaining 71 per cent for applications received prior to 1920. The permit inspections resulting from the large increase in applications received commencing in 1919 and 1920 will occur during the next two years.

#### STATISTICAL SUMMARIES AND DIAGRAMS.

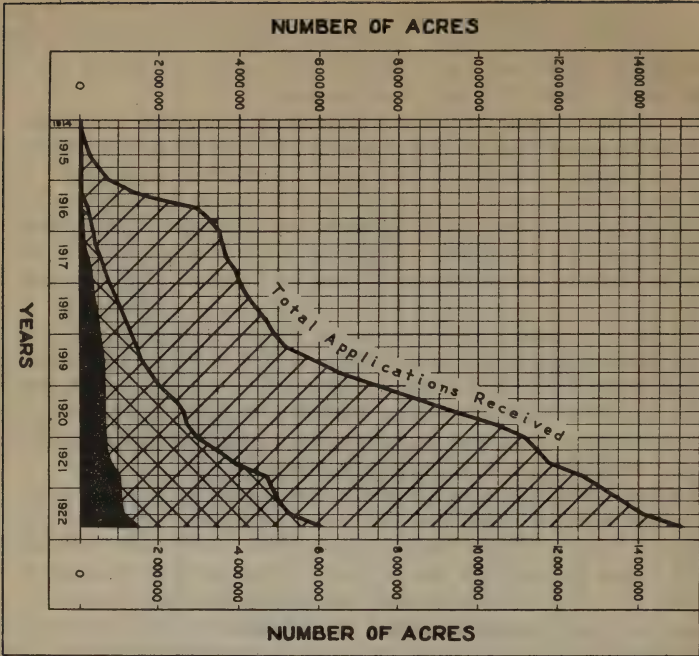
The activities of the Division in connection with applications filed under section 11 of the Water Commission Act are shown graphically in the accompanying diagrams. These deal altogether in cumulative totals at the end of quarterly periods, and cover the entire time since the office began to function.

Plate 3 shows in one part the action taken upon applications. It presents graphically in cumulative form by quarterly periods the total number of applications received, the number granted, the number cancelled or withdrawn, and the number pending. Plate 3 in the other part shows in cumulative form the total power applications, and agricultural applications on which action was pending at the end of each quarterly period.

Plate 4 shows, cumulatively, the total acreage to be served and total horsepower to be developed by all applications filed up to the end of each quarterly period.

# GRAPHICAL SUMMARY OF APPLICATIONS AND STATUS THEREOF

## ACREAGE APPLIED FOR



## THEORETICAL HORSEPOWER APPLIED FOR

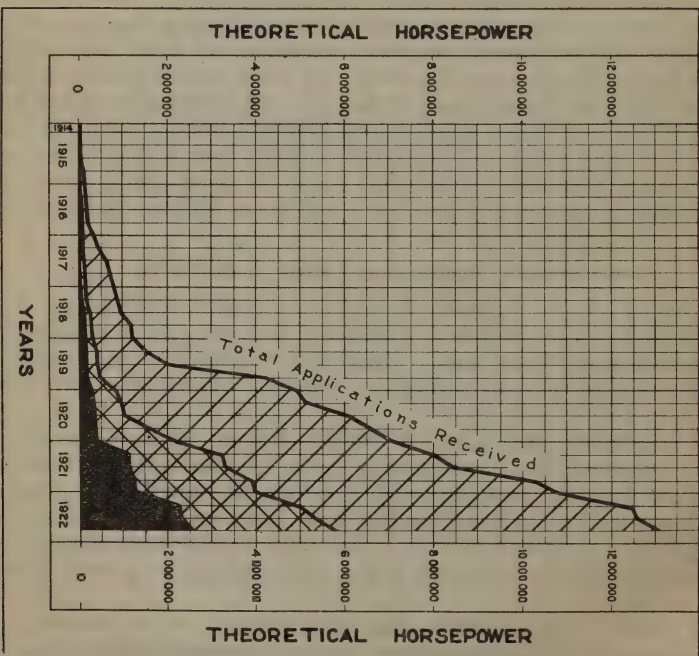


Plate 5 shows, cumulatively, the total second-feet for direct diversion and total acre-feet for storage included in all applications filed up to the end of each quarterly period.

The trend of the lines showing these cumulative totals is significant in many respects.

In Plate 3 the line showing applications received presents a decided break about the first of the year 1919. Prior to this date applications were received at an average rate of twenty-three per month. Since that date applications have been received at an average rate of forty-two per month. This increase in rate is to be accounted for no doubt in large part by the close of the World War. The passage of the Federal Water Power Act also had an effect, as will be pointed out in more detail later.

Not only have the applications been received in increased numbers during the past four years, but they have also represented larger projects. In this connection reference is again made to Plate 2 on page 11. The acreage to be benefited by the agricultural applications filed has averaged 42 per cent greater during the past four years than during the preceding four years, and the theoretical horsepower to be generated under applications for power purposes has averaged 129 per cent greater.

This combined increase, both in the number of applications received and in the magnitude of the projects contemplated in the applications, explains at least in part the rapid upward trend, after January 1, 1919, of the graph of applications pending. Applications for large amounts are generally more complex and require much more consideration. The number of applications awaiting action was therefore increasing because of the inability of the office to dispose of applications at a rate equivalent to that at which they were received.

There is a break, about April 1, 1922, in the line showing applications pending and it takes a downward trend, but a line showing permits pending if such a plat were drawn would at the same time take a sharp upward trend. The major portion of field work in connection with an application takes place after it is granted. Therefore, a marked increase in the field work may be expected.

There is also food for thought in the fact that of the applications thus far acted upon a large proportion represent smaller projects, while of the applications with action yet pending there is a considerable proportion representing larger projects.

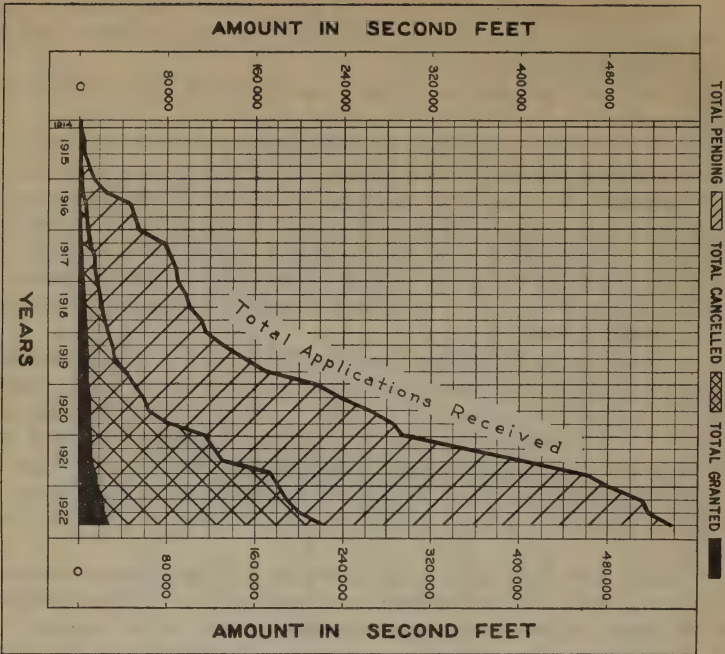
These graphs indicate several things. They convey some picture of the progress and development of the work of the Division of Water Rights. They suggest something of the service performed when an application is cancelled from the records and the filing ceases to be a deterrent to later applicants, but their greatest interest lies in their showing as to what may be in store for California in the near future.

The development of California's greatest natural resource passes first in review before the office of the Division of Water Rights and is epitomized on the graphs shown on plates three, four and five. Each acre which it is proposed to irrigate and each unit of water power which it is proposed to develop is to be irrigated or is to be developed by a plan which has crystallized in someone's mind to such a degree that it can be expressed by the statement of the plan which is a necessary part

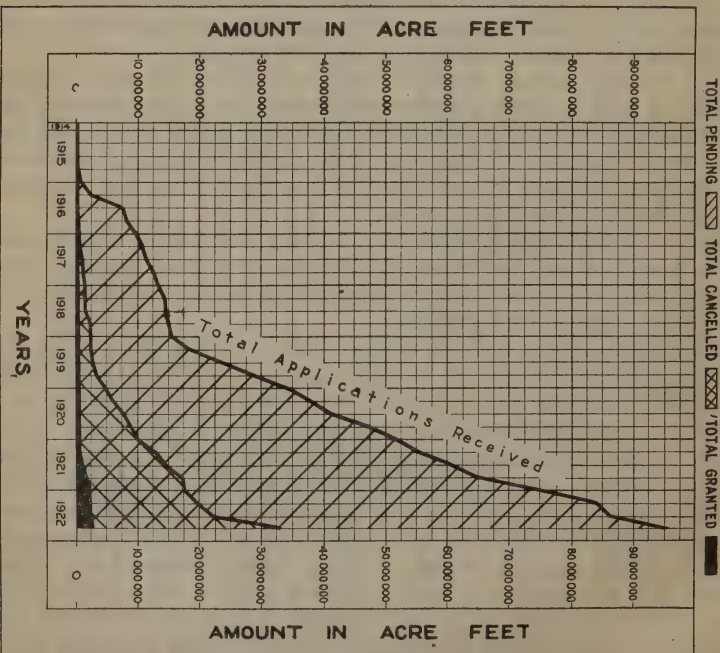


# GRAPHICAL SUMMARY OF APPLICATIONS AND STATUS THEREOF

## SECOND FEET APPLIED FOR



## ACRE FEET APPLIED FOR





of an application before the Division. A very large proportion of the developments proposed are not feasible now and there is not water enough for all which have been proposed. Neither can capital be found available to finance at a rapid rate even those projects which are feasible now, nor are there settlers in sufficient numbers for the lands which it is proposed to irrigate, nor power users for the power development which it is proposed to build.

Nevertheless, the plans which have been made, and which are now on file, were made in response to a demand which now exists for an increased area of irrigated land and an increased power development, and whether the ratio of constructed projects as compared to filings is large or small has little bearing on the matter, for certainly some percentage of these projects will be constructed.

Probably the average lapse of time between filing for water and beginning construction on a large project is more than five years, hence they indicate that the state is now entering a period of development greatly surpassing its past. The greatest part of the future development of California must come about by a greater utilization of the waters of the state and the first step in the utilization of these waters is the filing before the Division of Water Rights, which filing must soon after be accompanied by a definite plan for the use of the water filed on. The graphs not only indicate that the state is now entering on a greatly accelerated period of development, but they show that as yet no slackening in this accelerated rate of progress is in sight.



## CHAPTER III.

### ADJUDICATIONS AND COURT REFERENCES.

The Water Commission Act, as amended in 1917 (sections 25 to 36f, inclusive), provides a complete procedure for the determination by the Division of Water Rights of all water rights by appropriation upon any stream, stream system, lake, or other body of water, such determination to be confirmed or modified by court decree. By virtue of the sections referred to, the Division of Water Rights may supplement with an effective and expeditious method the work of the courts in adjudicating water rights by appropriation.

The act also provides (section 24) that in case a suit is brought in the superior court involving the determination of water rights, the case may, in the discretion of the court, be transferred to the Division of Water Rights for investigation as referee. By this procedure, riparian rights, as well as rights by appropriation, may be determined.

#### **Necessity for Determination of Water Rights.**

Since December 19, 1914, the date on which the Water Commission Act went into effect, water rights by appropriation can be acquired only under the provisions of the act, in which case such rights are determined through the procedure provided in the act for supervision over the acquisition of rights by appropriation and described in Chapter II.

However, most of the present irrigated acreage in the state acquired its rights prior to that time and the loose methods of filing then existing and lack of supervision to determine whether all or any part of these rights have become vested by use has resulted in the existence of a vast number of rights undefined and in many cases even unrecorded.

One of the important functions of the Division of Water Rights is to protect the vested water rights on any stream system by administering the distribution of water to the various diversion systems entitled to its use, under the provisions of the Water Commission Act as amended in 1921 (sections 37 to 37e, inclusive). Before such administration can be undertaken, however, it is necessary that all water rights from the stream system shall have been determined.

#### **Procedure.**

Proceedings for the determination of all water rights by appropriation from any stream system, may be undertaken by the Division of Water Rights, either upon its own initiative or upon the receipt of a petition signed by one or more claimants to the use of water from such source. The procedure provided in the Water Commission Act closely resembles that which has been successfully practiced in Oregon and Nevada for some years, the constitutionality of which has been upheld by decisions of courts in those states and also of the Supreme Court of the United States. (*In re Willow Creek*, 74 Or. 592, 144 P. 505, 146 P. 475; *Vineyard Land and Stock Company vs. District Court of Fourth Judicial District of Nevada in and for Elko County et al.*; 171 P. 166; *Pacific Livestock Company vs. Lewis*, 36 Sup. Ct. 637 (Reporter System)).

Adjudication proceedings under sections 25 to 36f, inclusive, of the act are initiated by the filing of a petition signed by one or more claimants or by action of the Division on its own initiative. An order is entered by the Division designating the stream system to be investigated; notice is published; a thorough investigation and compilation of data is made by Division engineers; notice is published setting a date on or before which proofs must be filed by claimants; forms for proofs are supplied by the Division; claimants are assisted in making their proofs; the proofs are assembled and submitted to public inspection; claimants are given opportunity to contest any proof or proofs; contests are conducted at a hearing; an order of determination is entered; opportunity is given dissatisfied claimants to show good cause and thereby secure a reopening of proceedings; the order of determination as first entered or as modified on rehearing is printed and a certified copy is filed with the clerk of the Superior Court in the jurisdiction wherein the investigation is made; an order from the court setting a date for hearing is obtained; notice of such hearing is published and served by registered mail; any time at least ten days prior to date of hearing parties aggrieved may file a notice of exceptions to the order and thereby secure a hearing in court and a determination made by the court. In case no exceptions are filed the court enters the order of determination filed by the Division, as its decree.

In the determination of rights under court reference (section 24 of the act) the Division of Water Rights follows the procedure provided in sections 25 to 36f of the act, as closely as the same may be applicable to the conditions. In such cases, however, it is not bound to follow any formal procedure, and any unnecessary steps may be eliminated which will accomplish a saving of time and money to the litigants.

#### **Merits of Procedure.**

The legal questions in connection with water litigation are complex but their solution is rendered more easy if they can be approached freed from the confusion entailed through conflicting evidence as to fact. The facts as to water supply, area irrigated and irrigable under any individual ditch, capacity of ditch and other related matters can be more accurately determined in the field than elsewhere. Testimony can be more accurately sifted in the light of such knowledge and with the help of the personal familiarity gained during the time such data are being secured. Furthermore, isolated court actions can not always sufficiently consider all matters which might have a bearing on the situation.

The provision of the Water Commission Act regarding adjudication of vested rights places on the Division of Water Rights the task of securing this physical data and taking testimony as to facts not determinable by a survey, leaving the legal questions to be determined by the court in regular court procedure. By this method all rights on the stream are brought into the proceedings and all matters having weight in the decision are presented at one time.

The merits of such a procedure are manifest but it is believed pertinent to emphasize the following points:



First, adjudication proceedings may be initiated in advance of actual conflict between water users and, by settlement of rights involved, actual injury to the holders of vested rights due to diversions by junior upstream appropriators may be averted. Trouble may thus be anticipated and forestalled, the continuance of amicable and neighborly relationships promoted, and strife and litigation reduced to a minimum.

Second, all rights by appropriation may be determined by adjudication proceedings and all rights whether appropriative or riparian may be determined by proceedings under court reference. A comprehensive determination results in either case and a single procedure thus determines rights which undetermined might be the basis for numerous individual suits.

Third, the resulting determination is based upon data collected by specially trained engineers, who are state employees and disinterested parties.

Fourth, a complete and thorough investigation and survey of the entire stream system is made, including an extensive series of stream flow measurements which is, when necessary, extended over more than one run-off season.

Fifth, the physical facts of the case are established and presented in the form of maps, tables and reports, and most of the historical facts are ascertained through the medium of written claims, all of which information is secured by a direct, simple, and effective procedure, at a reasonable cost and without unnecessary delay, and is presented in such form as to insure findings as nearly correct as human intelligence permits.

#### Adjudication Proceedings Undertaken.

The following adjudication proceedings under sections 25 to 36f of the Water Commission Act, have been undertaken by the Division of Water Rights or by its predecessor, the State Water Commission:

TABLE 3.  
Summary of Adjudications.

Stream system	Location	Date of order initiating	Status Oct. 1, 1922	Remarks
Stanislaus River.	Alpine, Calaveras, Tuolumne, Stanislaus and San Joaquin Counties.	Aug. 24, 1917.	Pending.....	Order of determination entered by Division of Water Rights, Sept. 21, 1922.
West Fork Carson River.	Alpine County.....	June 23, 1919.	Completed....	Findings of State Water Commission confirmed by decree of Superior Court of Alpine County, entered November 29, 1921.
Oak Creek..	Inyo County.....	Sept. 26, 1921.	Pending.....	Collection of engineering data completed July 1, 1922.
Shasta River.	Siskiyou County.....	Dec. 21, 1921.	Pending.....	Collection of engineering data about 60% completed.

#### STANISLAUS RIVER.

The Stanislaus River stream system is an important tributary of the San Joaquin River from the east, and traverses the counties of Alpine,

Calaveras, Tuolumne, San Joaquin, and Stanislaus. The water rights involved include some of the oldest in the state, some dating back to the early fifties, when the waters were used for the famous placer workings of Columbia, Angels Camp and Sonora. In recent years, power development in the Sierras and the further development of irrigated areas in the valley have so drawn upon the resources of the river that their fullest utilization is now required.

Adjudication proceedings were undertaken upon receipt of a petition from the Oakdale and South San Joaquin Irrigation Districts, representing a total of 145,327 acres of land on the main floor of the San Joaquin Valley.

The engineering data were collected during 1917 and 1918. All proofs of appropriation were submitted, and an abstract of all claims filed was mailed to each of the claimants in 1919. A series of hearings on contested claims was held during the summer of 1920; all briefs and legal papers were filed by the various claimants and contestants early in the following year. An order of determination was entered by the State Water Commission on July 20, 1921, but on petition a rehearing was held in November, 1921. The final order of determination was entered by the Division of Water Rights on September 21, 1922.

The order of determination shows fifty-eight water rights, covering 1847.53 cubic feet per second direct diversion for agricultural purposes, 791.67 cubic feet per second direct diversion and 128,289 acre-feet per annum storage for power purposes, 209.20 cubic feet per second direct diversion for public service purposes, and 1.75 cubic feet per second direct diversion for mining purposes.

#### WEST FORK CARSON RIVER.

The West Fork of Carson River is an interstate stream, traversing Alpine County, California, and uniting with the East Fork of Carson River in Douglas County, Nevada. There are twenty-nine ditches diverting from the West Carson stream system within the State of California, supplying water for irrigation to about five thousand acres of land. In addition, there are approximately ten thousand acres of land within the State of Nevada which are irrigated with water diverted from the stream below the state line.

The Carson Valley was one of the earliest agricultural areas to be developed in the west. As the climate is arid, making irrigation necessary, the resources of the West Fork of Carson River were gradually drawn upon for the development of new land until, in about the year 1900, injury resulted to lower Nevada users due to extensive diversions above them. This condition led to a suit in the federal courts, with all of the Nevada users from the river as complainants and naming all of the California users from the river as defendants. On November 27, 1905, a decree was entered by the federal court, granting the Nevada users the exclusive right to the use of all of the waters of the West Fork of Carson River, whenever the same were required for irrigating their lands as they then existed, for the period of seven days out of every fourteen days, beginning on the first Monday of June of each year, and continuing to the end of October of each year.

Following this, the Nevada users had their water rights adjudicated under the Nevada law and the distribution of water in the seven day period during which they were entitled to its use was placed in the hands of a watermaster acting under the supervision of the State Engineer of Nevada. Under such administration, the distribution of water has apparently been handled to the satisfaction of all concerned.

In the meantime, new areas were put under irrigation in California, until in August, 1916, several of the lower California users complained to the State Water Commission that they were experiencing difficulty in obtaining the water to which they were entitled. Being familiar with the advantages which the Nevada users had obtained under the Nevada law, they desired to follow the same procedure. It was not until the Water Commission Act was amended in 1917, however, that this was possible, and a short time thereafter the adjudication was begun.

The engineering data were collected in 1920 and proofs of appropriation were submitted in that year followed by completion of the abstract of claims early in 1921. A hearing was held in June of that year and the order of determination was entered by the State Water Commission in July. The findings were confirmed by a decree of the Superior Court of Alpine County, entered on November 29, 1921.

The decree established thirty-nine water rights, covering 63.16 cubic feet per second direct diversion and 9637 acre-feet per annum storage, all for use for agricultural purposes.

#### OAK CREEK.

The Oak Creek stream system is the source of water supply for about two thousand acres of irrigated land in Owens Valley, situated immediately north of Independence, Inyo County. It originates in perennial snow banks near the summit of the Sierras and flows in an easterly direction to a point about two and one-half miles northwest of Independence, where the flow is distributed to four main ditches by means of a division box which was installed about the year 1872.

The use of water from Oak Creek dates from the establishment of Fort Independence, on July 4, 1862. The original fort covered an area one mile square, and a considerable portion of this area was cultivated and irrigated with water from Oak Creek by the soldiers who occupied the fort. In the later sixties, various settlers who located around the fort cleared considerable land and irrigated it with water from Oak Creek.

About 1870, the early settlers formed an association known as the "Oak Creek Water Users Association," in which the water rights of all members were recognized as of equal priority. Each member was allotted a certain number of shares in the association, in proportion to his irrigated acreage. The association constructed a division box on the stream which automatically distributes the flow to the four main ditches, in proportion to the number of shares owned by the members supplied by the respective ditches.

In recent years, subsequent appropriators have constructed ditches diverting water from the stream above the division box of the association. While these subsequent appropriators recognize the prior rights



of the association, contention has arisen over the amount of water to which the association is entitled.

Adjudication proceedings were undertaken upon receipt of a petition signed by all of the members of the Oak Creek Water Users Association, as well as by several of the subsequent appropriators.

The engineering data were collected during the period between May 20, 1922, and July 1, 1922, and proofs of appropriation will be called for in the near future.

### SHASTA RIVER.

The Shasta River stream system is an important tributary of Klamath River from the south, and traverses Siskiyou County. As in the case of the Stanislaus River, the waters of Shasta River were used for mining purposes in pioneer days, and some of the water rights date back to the early fifties. Agriculture soon superseded the mining industry in importance in Shasta Valley, however, and the extent of the use of the waters of the stream system for irrigation has increased until there are at present over thirty thousand acres of irrigated land in the valley.

In July, 1921, several of the lower water users, possessing very old rights, complained to the Division of Water Rights of lack of water due to diversion by permittees of this office. An investigation was made by the Division followed by a conference with representatives of the Grenada Irrigation District, the latest appropriator on the stream, whose diversion was responsible for the complaint, and the directors of the district agreed to operate their pumping plant in such a manner as the Division should direct. An engineer of the Division was stationed in the valley for the remainder of the 1921 irrigation season, and the district's pumping plant was operated in such a manner as to allow ample water to pass down to the lower users, at the same time permitting the district to utilize such water as was available for it.

The supervision of the diversion of water from Shasta River during the period of shortage in 1921 demonstrated to the water users the advantages of state supervision of the distribution of water. Realizing that a complete adjudication of all of the water rights on the stream would be necessary as a basis for administration, twenty water users, representing over five thousand acres of irrigated land, submitted a petition requesting such proceedings. An order granting the petition and initiating the proceedings, was entered by the Division of Water Rights on December 21, 1921.

Collection of the field data was commenced on May 1, 1922, and is about sixty per cent completed at the time of this report.

### COURT REFERENCES RECEIVED.

Suits involving the determination of water rights on the following stream systems have been referred by Superior Courts to the Division of Water Rights or to its predecessor, the State Water Commission, for investigation as referee, under the provisions of section 24 of the Water Commission Act:



**TABLE 4.**

**Summary of Court References.**

Stream system	Location	Date of order of reference	Status October 1, 1922	Remarks
Red Rock Creek.	Lassen County.....	May 27, 1916.	Closed.....	Case failed of completion because of involved land ownerships and other pending litigation.
Willow Creek.	Lassen County.....	June 12, 1916.	Completed.....	Decree entered April 16, 1918.
San Pedro Creek.	San Mateo County.....	Sept. 6, 1917.	Completed.....	Decree entered May 12, 1921.
North Fork Cottonwood Creek.	Shasta County.....	June 6, 1919.	Completed.....	Decree entered June 9, 1920.
Hat Creek	Shasta County.....	March 29, 1920.	Pending.....	A stipulation has been drawn up which has been tentatively approved by all attorneys involved.
Burney Creek.	Shasta County.....	Nov. 25, 1921.	Pending.....	Collection of engineering data completed July 27, 1922.

#### RED ROCK CREEK.

The Red Rock Creek stream system rises in the Warner range in northeastern Lassen County and flows in a southerly direction onto Madeline plains. The flow is utilized for the irrigation of about thirty-two hundred acres of land.

The case of *McKissick Cattle Company vs. Union Land and Stock Company*, involving water rights on this stream system was referred to the State Water Commission for investigation as referee, by the Superior Court of Lassen County. An extensive field investigation of the water supply and use of water from the stream was made by the Commission, the results of which were submitted to the court. The case failed of completion, however, because of involved ownerships of land and other pending litigation.

#### WILLOW CREEK.

The Willow Creek stream system rises near Hayden Hill, in the northern part of Lassen County, and flows in a general northerly direction to its junction with Ash Creek in Big Valley. The flow is utilized by five ranches for the irrigation of about ten hundred and fifty acres of land.

The case of *Johnson et al. vs. Hill*, involving all water rights on the stream, was referred to the State Water Commission for investigation as referee, by the Superior Court of Lassen County. A hydrographic study of the stream system was made by the Commission covering the 1916 irrigating season, a report of which was made to the court. The case was tried by the court on July 2, 1917, the Commission's engineer attending the trial as a witness. Judgment was entered in favor of the plaintiffs, on April 16, 1918.

#### SAN PEDRO CREEK.

The San Pedro Creek stream system is located in San Mateo County, about twenty miles south of San Francisco. The flow is utilized for the irrigation of about four hundred and twenty-five acres of riparian land

intensively planted to artichokes and garden truck for the San Francisco market.

The case of *Tobin vs. Brown et al.*, an action brought by a lower riparian owner naming all other users from the stream as defendants, was referred to the State Water Commission for investigation as referee, by the Superior Court of San Mateo County. The Commission made a field investigation covering a period of two years, in which a thorough study of the water resources of the stream system was made, and the areas subject to economical irrigation, with their respective water requirements, were determined. Based upon the report of the Commission, a stipulation was prepared embodying a schedule for the distribution of the summer flow among the various claimants, which stipulation was signed by all parties to the action. A decree conforming with the stipulation was entered by the court on May 12, 1921.

#### NORTH FORK COTTONWOOD CREEK.

The North Fork of Cottonwood Creek stream system rises in Shasta County, about fifteen miles west of Redding, and flows in a southeasterly direction to its confluence with the main Cottonwood Creek, near Gas Point. The flow is utilized for the irrigation of about twenty-two hundred acres of land, including about sixteen hundred acres in the Happy Valley Irrigation District. The district plans to provide for the irrigation of an additional area of about sixteen thousand acres of land, by the construction of three storage reservoirs. The first of these, Misselback Reservoir, has recently been completed, providing capacity for the storage of fifty-seven hundred acre-feet of water per annum.

In the spring of 1919 a suit was brought in the Superior Court of Shasta County by the Bee Creek Ditch and Water Company, naming all of the other water users from the stream system as defendants, and appealing to the court to establish the relative rights of the various parties. The court then entered an order transferring the case to the State Water Commission for investigation as referee. The Commission made a field investigation of the water supply and use of water from the stream system covering the 1919 irrigation season. The various parties were able to agree as to the irrigated acreage under each ditch and consequently it was not necessary to make a survey of the irrigated land. Proofs of appropriation were filed by all parties to the suit, and an abstract of claims was mailed to each party. Practically all of the claims were contested.

A hearing on contested claims was set for April 12, 1920. Before proceeding with the formal hearing, however, the attorneys for the respective parties, aided by the representatives of the Commission, were able to arrive at an agreement for the allotment of the water. This agreement was signed by all parties to the suit, and in accordance therewith a decree was entered by the court on June 9, 1920.

The decree established thirteen water rights, covering 31.25 cubic feet per second for agricultural purposes, 2.00 cubic feet per second for mining purposes, and 0.90 cubic feet per second for power purposes.

#### HAT CREEK.

The Hat Creek stream system rises in the eastern part of Shasta County at the foot of Mount Lassen, and flows in a general northerly

direction to its confluence with Pit River, near Carbon. Near Cassel, Rising River enters from the east, supplying between three hundred and five hundred cubic feet per second to the flow at all seasons of the year. The Pacific Gas and Electric Company has recently constructed two power plants on Hat Creek below Rising River.

Above the influx of Rising River, the entire summer flow of Hat Creek is utilized for the irrigation of about twenty-five hundred acres of land. In recent years, lower users on this portion of the stream system have experienced difficulty in obtaining sufficient water, on account of increased use by land owners above them. This condition led to the suit of *Doyle et al. vs. Massie et al.*, in the Superior Court of Shasta County, which is an action brought by several of the lower users naming all other water users from Hat Creek above its confluence with Rising River as defendants.

The case was referred by the court to the State Water Commission for investigation as referee. A field investigation was made covering the 1920 and 1921 irrigation seasons, which investigation included a study of the water supply and duty of water, and also a complete plane table survey of all ditches and irrigated lands. Based upon the results of this investigation, a proposed stipulation has been drawn up by the Division of Water Rights, which stipulation has been tentatively approved by attorneys representing all parties to the suit. This stipulation will be submitted by the various attorneys to their respective clients in the near future, with recommendations that it be signed by all parties involved.

The proposed stipulation allots to each water user a definite quantity of water apportioned according to area irrigated, and further provides for a schedule of rotation to be operated between June 1st and October 19th of each year.

#### BURNEY CREEK.

The Burney Creek stream system rises on Mount Burney, in the eastern part of Shasta County, and flows in a general northerly direction to its confluence with Pit River, immediately below Burney Falls. The flow is utilized for the irrigation of about fifteen hundred acres of land in Burney Valley.

In 1916 a suit was brought in the Superior Court of Shasta County by Ednah M. Black, one of the lower water users, naming three upper users as defendants, and seeking to enjoin them from using water to her injury. Owing to the fact that the litigants were able to reach a temporary working agreement as to the use of water, the suit was not pressed until the fall of 1921, when it was referred by the court to the Division of Water Rights for investigation as referee. The Division made a preliminary field investigation, as the result of which a report was made to the court recommending that all other water users from the stream system be brought into the suit, in order that the findings would result in a complete adjudication of all water rights from the stream system. Acting upon this recommendation, the court ordered the plaintiff to file an amended complaint, naming eight additional water users as defendants.

A field investigation of the water supply and use of water from the stream system was made by the Division of Water Rights in July, 1922, a report on which is now in the course of preparation.



## CHAPTER IV.

### ADMINISTRATIVE DISTRIBUTION OF WATER.

Based upon experience in the seventeen western states in which irrigation is generally practiced, it has become recognized that a complete code of water laws must, in addition to providing a system for the supervision of the acquisition of new rights and a procedure for the adjudication of existing rights, provide the necessary administrative machinery under which water can be equitably distributed to the various diversion systems entitled to its use.

The importance of the administrative distribution of water is emphasized by the following quotation from "Elements of Western Water Law," by Mr. A. E. Chandler, former president of the State Water Commission of California:

"A little reflection will convince the reader that the goal sought in water right conflicts is the distribution of water among those entitled to its use. Litigation resulting in an adjudication of water rights is but the means to this end. Likewise, an orderly system for the proper record and control of the initiation of water rights is designed to fix the priority of the new rights so that the water may be distributed in accordance therewith without further adjudication or litigation."

#### Development of Law.

The first state to adopt an effective water code providing for the administrative distribution of water, was Colorado, in 1879. This code has been in effect, with minor changes, ever since its adoption, and has served as a model for legislative enactment in other states. Of the so-called "irrigation states," Kansas is now the only one which has not enacted legislation for the supervision of the distribution of water. A large portion of the state of Kansas is situated in the humid belt, however, and consequently the need for such legislation does not exist there to the same extent that it exists in the other western states.

In California, the principle of state supervision of the distribution of water was established when the Water Commission Act was passed in 1913. Section 37 of the original act empowered the Water Commission to supervise the distribution of water in accordance with the priorities established under the act, when such supervision would not contravene the authority vested in the judiciary of the state. The original act did not, however, specifically authorize the Commission to supervise the distribution of water to rights acquired before the act went into effect, or provide the necessary machinery for handling the distribution of water. It was not until the Water Commission Act was amended in 1921, that effective legislation providing for the administrative distribution of water was enacted.

#### Present Law in California.

At the 1921 session of the legislature, the "Water Master Bill" was passed as an amendment to the Water Commission Act (sections 37 to 37e, inclusive). This bill provides for the creation of "water districts"



by the Division of Water Rights, to include stream systems upon which all water rights have been determined. Upon written request from the owners of at least fifteen per cent of the diversion systems entitled to water in any water district, the Division may, if in its discretion necessity therefor exists, appoint one or more water masters for such district. Such water masters are authorized to divide the waters of the stream systems among the various conduits in accordance with their respective determined rights, and in the performance of such duty, may regulate diversion works and arrest anyone tampering with them after they have been so regulated. Changing or interfering with diversion works which have been regulated by a water master, constitutes a misdemeanor punishable by fine or imprisonment, or both. Any water user who is dissatisfied with a decision of a water master, however, has the right to appeal from such decision to the Superior Court of the county in which the regulation takes place.

#### **Experience in California.**

On some stream systems, early attempts were made to obtain regulation of the diversion of water through injunction proceedings. Such method necessitates numerous actions in court, however, involving great expense to the litigants. Furthermore, the results obtained are in most cases of but temporary value. The futility of attempting to accomplish satisfactory results by this method is now apparent.

Although there have been several streams in California where for many years the water users have, by mutual agreement, employed a *zanjero*, or water superintendent, to distribute water to the various ditches, the first instance of state supervision of the distribution of water occurred in 1919, when the Kings River Conservation Association appealed to the State Water Commission to appoint a water master to regulate headgate diversions from Kings River. The details of the operation of this and its ultimate result are described in Chapter VII.

The next instance of state supervision of the distribution of water occurred on the Sacramento River in 1920, which was described in the third biennial report of the Water Commission and which is briefly covered in Appendix II of this report.

The first and only water district which has been created under the provisions of the Water Commission Act as amended in 1921, is the West Carson Water District, in Alpine County. This district was created by an order of the Division of Water Rights entered on February 6, 1922, and embraces all territory included in the West Carson adjudication proceedings, which resulted in a decree entered by the Superior Court of Alpine County on November 29, 1921. On May 8, 1922, the Division of Water Rights received a petition signed by the owners of twenty-seven per cent of the ditches entitled to water in the district, requesting that a water master be appointed to supervise the distribution of water within the district. Early in August, the flow of the West Fork of Carson River reached such a stage as to necessitate the assuming of the duty of distribution of water by the Division of Water Rights. A water master was appointed, who administered the distribution of water within the district from August 7th to September 25th. No serious difficulties were encountered, and the situation was handled to the satisfaction of all parties involved.

### Experience in Other States.

Naturally the value of the experience of other states in the administration of their laws on the adjudication of rights and distribution of water will be interesting to California only in so far as conditions in these other states are comparable to those in California and also in so far as the complexity of the problems encountered indicate what may be expected in California.

Wyoming, Colorado, Nevada and Oregon probably have the most perfect codes in regard to adjudication and also administration of water, while Idaho is to the forefront in its system of distribution as actually practiced. In the first two, adjudications take place at regular intervals and all new rights are placed in their relative priority by the date of their filing. The amount of the diversion attached to this priority is determined in the adjudication and is henceforth administered by the water master. In the latter two states, adjudications are made at the will of proper authorities.

Adjudications establish a water right in priority and in amount, but to be operative the adjudication must be succeeded by distribution of the water either by mutual agreement or in the hands of an organization with police powers to make effective the court rulings. Since in some of the other states the streams were adjudicated many years ago, there has grown up a system of state administration of streams which is effective in accomplishing the object which is sought in water right litigation and in water law; that is, to distribute the waters of the stream to those individuals who have acquired the right to its use.

In Colorado, Wyoming, Utah and Idaho, probably the greatest development of areas feasibly irrigated by gravity has taken place. As compared to California much greater reservoir capacity has been constructed, partially because the climate is arid and farming operations can not succeed without water as they can in large parts of the semi-arid or sub-humid sections of California, partly because an effective law exists, partly because pumping from ground water is not feasible as it is in so large an area in California. In other words, conditions in these other states force the water user to secure his late water supply through the construction of surface reservoirs rather than by pumping from underground reservoirs.

As shown by the activity before this office in filings made for the purpose of building reservoirs, California is on the eve of an era of reservoir development to secure a gravity late water supply and it is thought that a short description of the more interesting developments of administrative distribution in other states on streams where reservoir development is large will be of interest because California must soon encounter and solve similar problems of distribution. The agency which proposes to build a reservoir must be assured, before proceeding, that its stored water will reach the land for which it was built.

It is not always necessary to appoint a water master to regulate the diversions from a stream. In small communities all irrigated from one stream and where each man is acquainted with his neighbor the division of the water is often accomplished by mutual agreement. In larger stream systems where the users are widely separated the tendency of each water user is to divert at all times the water he needs although

some other has a right to its use. It was this condition that first made a water master necessary.

The duties of the first water master were primitive in the extreme. He was appointed by the state on a per diem basis. He was generally a farmer living in the vicinity. When complaint came from the owner of senior right that he was not getting the water belonging to that right, the water master merely went out on the stream and closed down the headgates of enough of the junior rights above the complaining right to insure that the requisite flow would reach the complainant. The water master perhaps took such action not more than half a dozen times each year and then only when complaint was lodged. He made no effort to anticipate complaints, nor did he spend time in study of the varying phases of the stream.

Such a system is still in effect on the smaller and more isolated streams of these states, even when on other streams a more complicated administration is necessary. It answers the requirements fairly well at a minimum expense only because the general community has a fair knowledge of conditions.

It was when water users became widely distributed in a stream basin that need for more highly organized administration was felt, and particularly after the first reservoirs were built it became necessary to summon men of great technical knowledge and high administrative talent to the work. Although there is not in the entire west any area of land with the extent and fertility of the Great Valley of California, which at the same time has water available and easily diverted for irrigation, yet there are extremely large areas of irrigated land watered from a single stream system having perhaps complex problems of distribution comparable to those which will be encountered in California.

Development on these stream systems would long ago have ceased had it not been possible to work out a fair and just method of distribution in the face of what would seem hopelessly complicated conditions. The best examples of efficient distribution of irrigation water are found in Colorado on the South Platte River and in Idaho on the Snake River.

#### **South Platte River.**

The waters of this stream are probably more intensively developed for irrigation than any other major stream in the United States. There are now 1,100,000 acres irrigated in Colorado from this stream and the area is continually increasing. To serve this there are now constructed 185 reservoirs averaging 5000 acre-feet in capacity and aggregating in excess of 900,000 acre-feet. A few of these reservoirs are in the headwaters on the streams but most of them are offstream and supplied by canals from the main stream and its tributaries. The developed area lies in a tract stretching about 300 miles along the river. Some of the reservoirs lie adjacent to the lands for which they were built, some many miles above and some many miles below. In operating these last the water goes to an area which has an old right while the agency building the reservoir diverts the natural flow which belongs to the old right. In one case an irrigation district constructed 19 reservoirs not one of which is above the lands of the district. Through the control exercised by the



water master the district secures the benefit by exchanging this stored water for natural flow which it diverts higher up.

It is at once apparent that such a system is a problem of very complicated operation. It is the outgrowth of over 40 years of experience in operation. It has not solved all the problems, being somewhat hampered by legislative restrictions, yet it is very efficient and satisfactory.

#### **Snake River.**

In Idaho a system which is on the whole more efficient has been worked out in the last ten years. The administrative unit has been made large enough to include all related diversions. The best example of this is on the Snake River on which the entire river and its tributaries have been placed under the control of one man who has in turn built up an efficient organization of subordinate technical men and water masters. The portion of the river from which diversions are made is about 300 miles long and from it and from tributaries there are irrigated about 1,250,000 acres with a possible extension of half as much again. The early appropriators were at the middle of the 300 mile stretch and there had been developed in this area about 400,000 acres served by about 40 different canals when development perhaps 100 miles below began. Here were built several ditches serving about 500,000 acres and these canals combined to build a reservoir of 800,000 acre-feet capacity in the extreme headwaters above the prior rights and supplemented this by another small reservoir below. Although the stream was administered by several water masters, each serving a part of the area in accordance with the usual custom, the people who had built the reservoir soon found that they were not getting their reservoir water but that the upper users now had a plentiful supply. This was because of divided control. With recognition of the fault the existing regulation was changed to enable it to cope with the situation. Some idea of the difficulties of administration is gained when it is realized that it takes 6 days for water to pass from the upper reservoir to the lower canals, that the natural discharge is continually changing and that the stored water must pass the headgates of 40 canals diverting a total of 12,000 second-feet. Nevertheless, the method of handling has solved these difficulties and is producing results satisfactory to all, so that development is going ahead rapidly. A 3,000,000 acre-foot reservoir will soon be built near the lower end by a group composing most of the water users on the river and the portion of its water belonging to the upper users will be exchanged for water in the upper reservoir and for natural flow. Other reservoirs are to be built on the tributaries and similar exchanges effected.

#### **Aim of Water Master Control.**

It is believed these instances serve to illustrate the essence of the desirability of adjudications and administrative distribution, that vested rights need be at no expense to protect their rights save for the nominal tax of the cost of distribution. This cost is almost negligible compared to individual court actions. At the same time under these safeguards unused waters may be appropriated and the upbuilding of the state go on to the benefit of all, unhampered by legal expense.



## CHAPTER V.

### SPECIAL INVESTIGATIONS.

Section 40 of the Water Commission Act is in part as follows:

“The State Water Commission is also authorized and empowered to investigate any natural situation available for reservoirs or reservoir systems for gathering and distributing flood or other waters not under beneficial use in any stream, stream system or lake or other body of water, and to ascertain the feasibility of such projects, including the supply of water that may thereby be made available, the extent and character of the areas that may be thereby irrigated, and make estimate of the cost of such project.”

The above gives the Division of Water Rights broad power to investigate any kind of an irrigation project. Many requests for such investigations have been received, but state funds for such work have never been available in large amount and most of the work so far undertaken has been financed by the interested parties. The work of the Division along these lines has proved particularly valuable in those cases where obscure matters relating to water and its use are under dispute.

There follows a short summary of the investigations which have been undertaken in the last biennium. The more important of these are treated more fully in succeeding sections of this report.

#### Kings River.

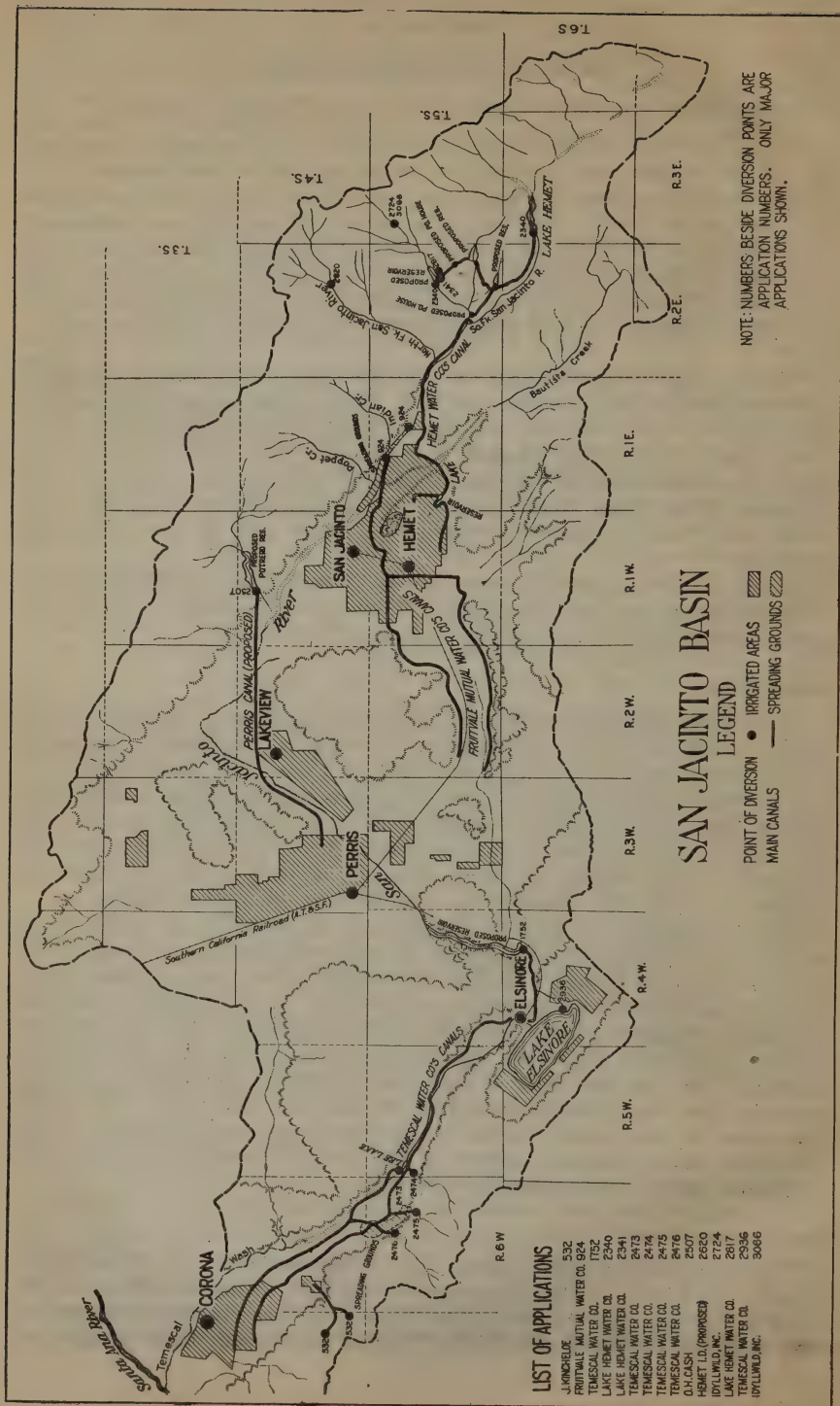
This work was commenced in December, 1917, as a special investigation to determine the diversions of existing water rights from Kings River, preparatory to the construction of Pine Flat Reservoir.

The work is still going on but has assumed larger proportions than was at first contemplated. It aided materially in defining the rights of the various ditch systems and has grown into the administrative distribution of the waters of Kings River in accordance with a schedule drawn up under the direction of the Division of Water Rights.

The importance of proper distribution of water is so great in its social and economic features, and the area watered from Kings River is so large, that Chapter VII of this report has been devoted to an interesting account of the work written by C. L. Kaupke, associate hydraulic engineer of the Division of Water Rights, who has been in charge at Fresno since the inception of the work. It was thought advisable in this article to review the history of the work up to the present time for it is believed that the close of the year 1922 marks the close of the period during which the investigative features were the most important and ushers in the time when administrative distribution of the water takes precedence.

#### San Jacinto River.

The San Jacinto River system lies in the western part of Riverside County, and is one of the important streams of southern California. It rises in the San Jacinto mountains, flows in a westerly direction, and at one time reached the Pacific Ocean, but at the present time the surplus



water flows into Lake Elsinore, and is there disposed of by evaporation. The general situation is outlined on Plate 5a, page 46.

The flow of the river is "flashy," varying widely between wet and dry years. The average annual discharge is about 50,000 acre-feet, a large part of which sinks in the stream channels and furnishes the underground supply for a large amount of irrigation by pumping.

Problems of water development on the San Jacinto are similar to those met with on all the streams of southern California, and it is believed that some description of the conditions along this river will be of interest because the underground water situation in southern California has become a major problem in the development of the state's resources. Many of the baffling underground water problems discussed in Chapter X of this report are encountered on the San Jacinto River.

Three comparatively large mutual companies are serving the major portion of the land irrigated from the San Jacinto River. These are Lake Hemet Water Company, the Fruitvale Mutual Water Company and the Temescal Water Company.

The Lake Hemet Water Company diverts from the natural flow of South Fork, Strawberry Creek and North Fork, and has storage on the South Fork in Lake Hemet. The lands served consist mainly of orchards in the vicinity of Valle Vista and Hemet. This company has an application before the Division of Water Rights for the diversion of water from Strawberry Creek to Lake Hemet in order to increase the storage available for their use. It is also proposed to develop power in connection with this diversion. The Fruitvale Mutual Water Company, which serves lands near San Jacinto, obtains its supply by direct diversion from the River, from submerged dams and tunnels and by pumping from wells. In order to increase the supply available from these underground sources the company has spread the flow of San Jacinto River on areas of coarse material adjacent to the river channel. Application for such use was made in 1917 and a permit issued by the then State Water Commission. The Temescal Water Company has wells located near the San Jacinto River in the Perris Valley from which it conveys water to Corona. An application for storage in Railroad Canyon, which connects Perris and Elsinore valleys, has been made by this company and is now before the Division.

In addition to these three companies there are many individuals and smaller organizations which are pumping from ground water in the area dependent on the San Jacinto River drainage basins. Some of these areas secure artesian flow. In others pumping has resulted in a general lowering of the ground water to such an extent that costs are becoming excessive and the quality of the water is affected. Lands in the vicinity of Perris have applications before the Division to spread the storm waters of the river, and also for surface storage on Potrero Creek. It is proposed to use the surface storage, together with the spread waters which will be recovered by pumping, to replace the supply which has been pumped locally for use on these lands. There is some pumping around Lake Elsinore, the largest organization for that purpose being at the southeastern end of the lake. As the lake is supplied from the surplus run-off of the river, which is disposed thereof by evaporation, any reduction in the present inflow would detract from the attractiveness of the lake. Therefore the interests which have the



mineral baths at Elsinore are opposed to further use of the water in the upper part of the drainage basin for irrigation.

All the applications pending before the Division have been extensively protested by all other interests on the river. In connection with these applications and protests the Division in 1921 made a field investigation of the conditions on the river and this disclosed that the necessary information on which the office could base its conclusions was not available. A meeting to which all interested parties were invited was arranged at Riverside in August, 1921. The situation was outlined and a cooperative investigation suggested which would cover a study of run-off and ground water conditions. As a result of the meeting an agreement was entered into between the five principal interests on the river and the State Department of Public Works providing for an investigation by the Division of Water Rights to be made with sufficient thoroughness to furnish a basis for conclusions on the extent of the water resources and the feasibility of their more complete utilization. The cooperating parties were the Temescal Water Company, the Elsinore Valley Water Users' Association, the Perris Valley Chamber of Commerce, the Fruitvale Mutual Water Company and the Lake Hemet Water Company, each of which furnished one thousand dollars. The Division of Water Rights has furnished two thousand dollars from its general investigations fund and the Division of Engineering and Irrigation has contributed one thousand dollars and also the use of an automobile and other equipment.

Field work was begun in October, 1921, and has been continued up to the present time. It is now practically completed and the report will be finished in January, 1923. A large part of the work has been directed toward a study of the ground water and the effect of spreading as practiced by the Fruitvale Mutual Water Company. Observations of the fluctuations of wells over the full area have been made, the extent of draft on the ground water canvassed, measurements of run-off made, and available existing data assembled. The season of 1921-22 was one of unusually large run-off, so that the conditions for replacement of ground water have been more than usually favorable.

#### **Lopez Creek.**

Another underground water problem was presented to the office in the application of the City of San Luis Obispo to divert water from Lopez Creek.

The recent series of dry years and the growing needs of the city created a serious shortage in municipal supply, and it was proposed to tap the natural flow of the nearest adequate source, which is Lopez Creek. However, Lopez Creek furnishes the principal irrigation water supply for the very rich agricultural area in Arroyo Grande Valley. Existing data were not sufficient on which to base action by the Division, and the conditions of very evident need by a city, opposed by a determined organization of riparian users, promised bitter and long drawn out litigation. The physical situation was complicated by the fact that during the summer months the flow of Lopez Creek in its lower channel was beneath the surface of the ground.

With funds provided by the applicant, and material field assistance from the protestant's organization, a short field investigation was



made by the Division, which showed it to be inadvisable to grant the application as it was presented. The applicants are now considering a modified plan involving storage.

#### **San Joaquin River.**

A study of the San Joaquin River was begun in June, 1920, at the request of the Madera Irrigation District. This was undertaken in the same way as that on Kings River just referred to and with the intention of securing data which would aid in defining rights preparatory to the proposed construction of Millerton Reservoir on the San Joaquin. This is going on still and has been under the charge of Harrison Smitherum, assistant hydraulic engineer of the Division of Water Rights. The work is treated fully under Chapter VIII, which has been devoted to an article by Mr. Smitherum.

The increasing value of the work, as the engineer and his assistants become thoroughly familiar with the difficult and peculiar local problems and are able to devote special study to their solution, should not pass without mention. The continuation of the investigation until it fulfils its original purpose is to be earnestly recommended.

#### **Return Flow in the San Joaquin Valley.**

The importance of this phenomenon was brought to the attention of the Division as a result of a number of applications received for the appropriation of water from the lower reaches of the San Joaquin River and tributaries. Measurements have been made since and including 1920.

The subject of return flow and the results obtained in the investigation are given in considerable detail in Appendix III "Return Water in Lower San Joaquin Valley". The magnitude of the return flow shows its importance as a source of supply. It is expected that this study will be continued, in greater detail than in the past, to such time in the future as will allow the formation of definite conclusions regarding the possible increase of this flow with the expansion of irrigation development in the valley.

#### **Use of Water in the Sacramento Valley.**

The rapid increase in irrigation development in the Sacramento Valley during the last decade, and the part which the rice industry has played in this development, has resulted in a considerable amount of work in the valley by the Division of Water Rights.

The majority of the acreage irrigated is under permit from the Division, the appropriations having been initiated subsequent to the passage of the Water Commission Act. Realizing that the irrigation of rice required a larger amount of water than that for general crops, the first permits were issued on the basis of one second-foot to forty acres, with the proviso that the amount granted could be reduced at the time of issuance of license if investigation so warranted. There was a considerable overlap in lands included under different permits which could only be straightened out by a familiarity with local conditions.

During the summers of 1921 and 1922, inspections were made of all projects diverting under permit from the Division, and a great deal

of data collected especially upon the use of water for rice and the general development of rice irrigation.

Results of this work, and of the work of the Emergency Water Conference in 1920, are discussed in Appendix II.

The high prices prevailing in 1918 and 1919, resulted in the planting of rice on lands which under normal conditions would be better suited to general crops, and upon which an excessive quantity of water was used. The crop was a new one in the state, and lack of long experience in its irrigation did not encourage a most economical use.

The final duty of water allowed under licenses for irrigation of rice will have an important effect upon the acreage which can be irrigated in the valley. No definite conclusions have been reached regarding the duty to be allowed as yet, it being felt that further information is desired upon use under more stable conditions before final determination.

#### **Salinity in Sacramento-San Joaquin Delta.**

The investigation of salinity conditions in the Sacramento-San Joaquin Delta was first undertaken in a comprehensive manner in the summer season of 1920, which was a year of unusually low summer flow in both the Sacramento and San Joaquin Rivers. This work has been continued during the past two years, which were both characterized by a considerably greater summer flow. There has thus been afforded an opportunity to observe the salinity conditions in years of varying river discharge. The effect on salinity of the increased summer flow is plainly reflected in the graphs accompanying Appendix I herein. A brief description of the investigational work carried on in this connection, and some conclusions drawn as a result thereof, are also included in Appendix I.

The increasing salinity content of the water supplies of the Delta is a grave problem confronting not only this region but the entire Sacramento-San Joaquin system. It is of great importance to the state that irrigation development on the upper streams be allowed to proceed while it is equally important that the vast enterprises and investments in the delta below be not endangered. The facts established by this investigation will be necessary in the final solution of this serious problem.

#### **Indian Wells Valley.**

At the request of the settlers in this region, a comprehensive water supply investigation is being carried on under the direction of the Division of Water Rights.

The Indian Wells Valley is in Kern County, and lies just east of the Sierra Nevada Mountains about half way between Los Angeles and Bishop, in the north of Inyo County. It contains a large area of fertile but arid land, and many attempts have been made within recent years to obtain an irrigation supply. The eyes of the landowners of the Indian Wells Valley have turned naturally toward Mono Lake to the north, where there is a comparatively large water supply, at the present time unused. However, Mono Lake is nearly 200 miles distant from the valley, and it is at once apparent that it is not feasible economically to transport the available supply this great distance

for agricultural purposes alone. There exist, however, at several points along the line which such a canal would take, possibilities for the development of hydroelectric power, the value of which would contribute materially toward the expense. The whole project thus hinges on the power possibilities. There had been no investigation of this feature, however, and there was only a rough idea of the water supply available and of the irrigable lands. To determine with definiteness whether or not Mono Lake offers a feasible source of water supply for the Indian Wells area, it was the desire of the residents that a thorough and impartial investigation be made of the whole project by the Division of Water Rights.

Accordingly, an agreement between the Kern County Farm Bureau and the State Department of Public Works has been entered into by the terms of which the farm bureau, in the interests of the proposed Indian Wells Valley Irrigation District and Fremont Valley will furnish funds, not to exceed \$7,000, for the investigation to be made by the Division of Water Rights.

The work has been placed in charge of Mr. John T. Whistler, formerly of the United States Reclamation Service, and is proceeding at the present time.

#### **Water Supply for State Institutions.**

The Division has been called upon at various times to advise relative to water supply or water rights of various state institutions. Some of these institutions have grown to considerable size and the problems encountered in securing an adequate water supply are similar in their diversity to those of cities of from five to ten thousand population under the wide variance in California conditions.

A thorough investigation was made of possible sources of supply and an estimate of cost prepared for Pacific Colony near Pomona, Los Angeles County.

Assistance was rendered in a similar investigation of the enlargement of the supply for the Napa State Hospital and Veterans' Home near Napa, Napa County.

Other investigations were made as to water rights and supply at the following state institutions:

San Quentin State Prison.

Folsom State Prison, at Folsom.

Whittier State School, at Whittier.

California Polytechnic School, at San Luis Obispo.

Mendocino State Hospital, at Talmage.

Preston School of Industry, at Ione.



## CHAPTER VI.

### COOPERATION WITH FEDERAL DEPARTMENTS.

#### U. S. Forest Service.

The cooperation which is received from the United States Forest Service is of a most valuable character and should not pass without acknowledgment.

Forty-one out of every hundred applications received by the Division are for appropriation within one of the nineteen National forests lying within the state, and the Forest Service renders to the Division a report upon each of such applications.

When an application is received for an appropriation within a National forest it is at once referred to the supervisor of that forest and further action is delayed pending receipt of his report.

This report includes the names of parties who may be affected by the proposed diversion and note of any special conditions which should be known by the Division before taking action. Definite recommendations are also included where the public may be affected by the proposed diversion.

Such investigations by men of local experience cover remote areas generally inaccessible and it would be difficult to overestimate the service thus performed without expense to the state by these agents of the federal government.

#### U. S. Geological Survey.

The water resources branch of the Geological Survey has developed a highly efficient and well organized corps of experts specially trained in the measurement of flowing water. Originally this organization operated entirely with funds furnished by the federal government but as the importance of the records secured became apparent came a demand that more gaging stations be established. The work grew beyond that which could be handled with the funds supplied by the federal government and local interests have contributed to the increasing costs while the execution of the work has remained in the hands of the Geological Survey. The Division of Water Rights contributed at the rate of \$10,000 per year to the furtherance of this work in California during the biennium.

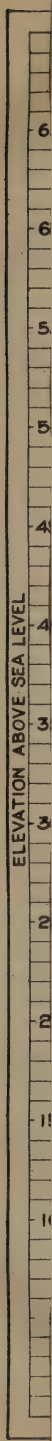
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#### Federal Power Commission.

In June, 1920, the long awaited act which authorized the Federal Power Commission became a law. This act defined the methods by which right of way across the *lands of the government* can be secured for power project developments. The State of California in the Water Commission Act of 1913, and amendments thereto, had defined the method by which the *waters of the state* can be appropriated for power and other uses.



ELEVATION ABOVE SEA LEVEL



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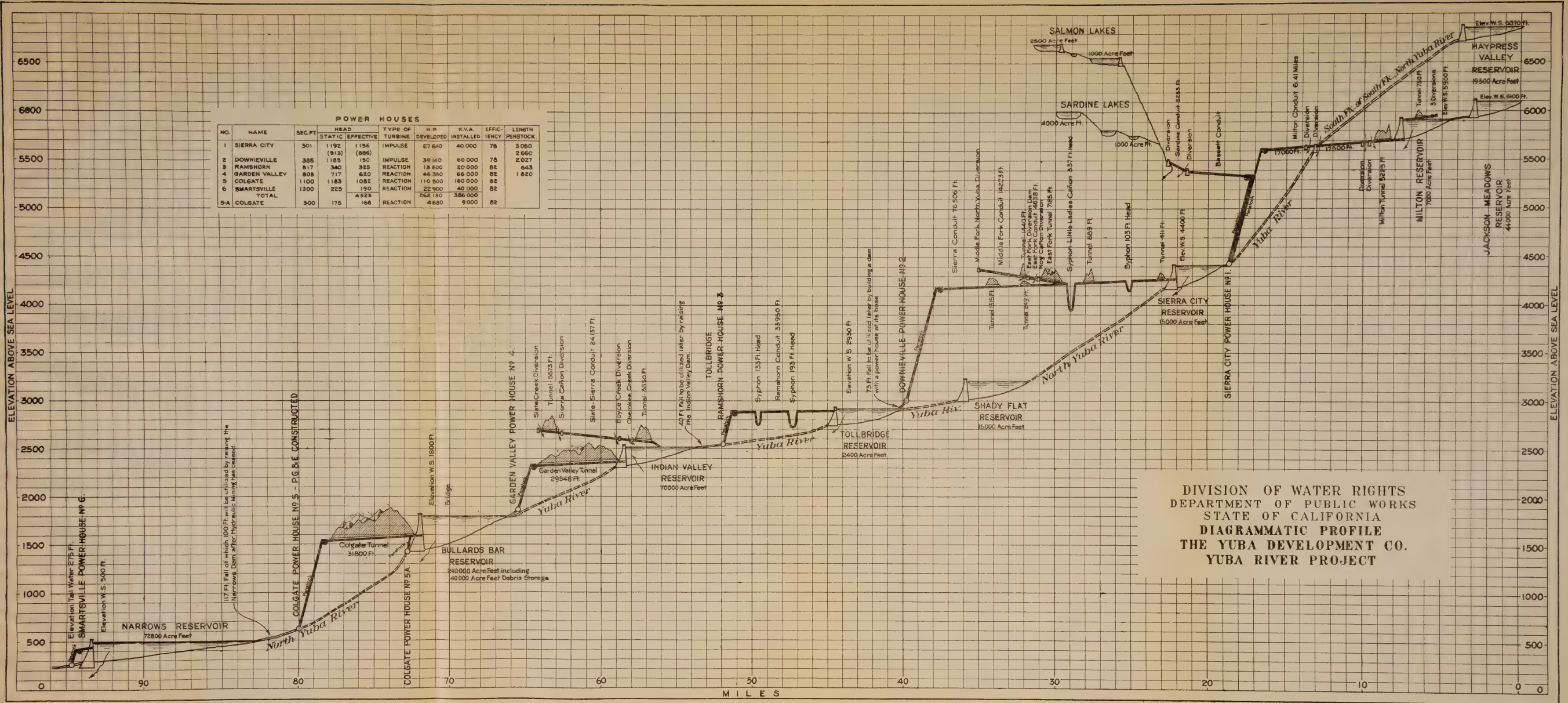
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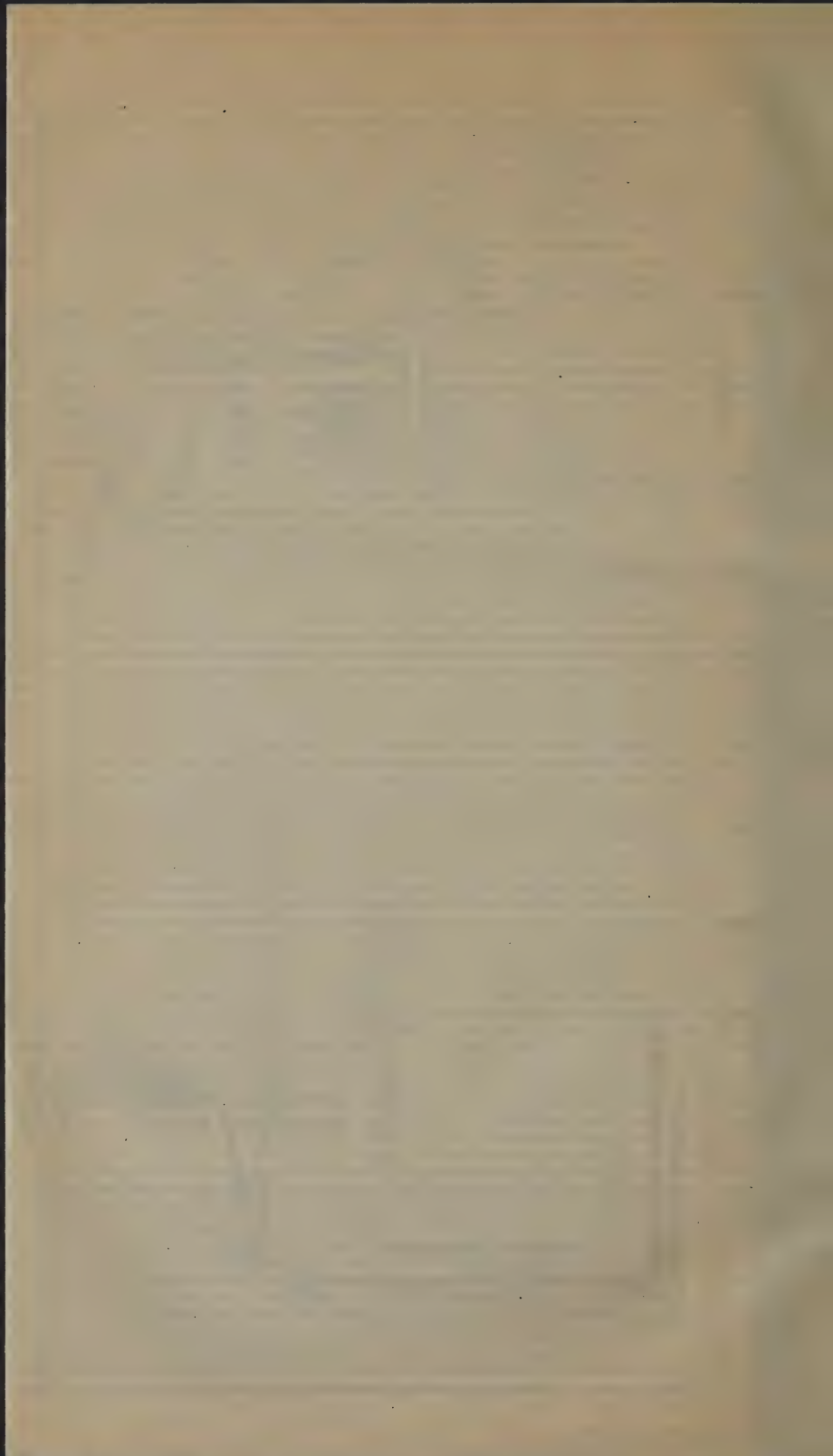
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POWER HOUSES									
NO.	NAME	SEC. FT.	HEAD		TYPE OF TURBINE	H.P. DEVELOPED	K.V.A. INSTALLED	EFFICIENCY	LENGTH PENSTOCK.
			STATIC	EFFECTIVE					
1	SIERRA CITY	301	1192	1156	IMPULSE	27 640	40 000	78	3060
			(913)	(886)					2 660
2	DOWNIEVILLE	385	1185	150	IMPULSE	39 160	60 000	75	2 027
3	RAMSHORN	517	340	325	REACTION	15 600	20 000	82	643
4	GARDEN VALLEY	808	717	620	REACTION	48 360	66 000	82	1 820
5	COLGATE	1100	1183	1082	REACTION	110 800	160 000	82	
6	SMARTSVILLE	1300	225	190	REACTION	22 900	40 000	82	
TOTAL				4 523		262 130	386 000		
5-A	COLGATE	300	175	166	REACTION	4 680	9 000	82	

DIVISION OF WATER RIGHTS  
 DEPARTMENT OF PUBLIC WORKS  
 STATE OF CALIFORNIA  
 DIAGRAMMATIC PROFILE  
 THE YUBA DEVELOPMENT CO.  
 YUBA RIVER PROJECT





For some years power development had been retarded by the failure of the federal government to pass such a law as that embodied in the Power Commission Act and during that period the growth of population in California had been rapid and the increase in prosperity great. There had grown up an increased demand for electrical energy.

To operate a power project an owner must have two rights. He must have a right of way for his works and he must have the right to divert water from a stream. Applications for diversion of water for power before the Division of Water Rights had been of comparatively minor consequence for several years, but with the passage of the act there were initiated a flood of new power projects. For the year previous, in anticipation of the passage of the act, activity had been large.

This activity is evidenced by the records of the Division of Water Rights which summarize as follows:

TABLE 5.

Summary of Theoretical Horse Power Applied For.

	Theoretical Horse Power	
From the passage of the Water Commission Act in 1913 to July, 1919, applications were received for	2,000,000	
In anticipation of the creation of the Federal Power Commission Act from July, 1919, to June, 1920, applications were received for	4,000,000	
From June, 1920, to October 1, 1922, applications were received for	6,500,000	
<i>Summing up:</i>		
Applications before the Division of Water Rights-----		12,500,000
Applications canceled	3,000,000	
Permits granted	2,200,000	
Applications acted on		5,200,000
Pending		7,300,000

Such a flood of applications found the Division unprepared but the personnel was increased as fast as possible to handle the work. The projects proposed are very complicated and in some cases contemplate the development of all the possible power in an entire river system as on the following streams:

Southern California—	Central California—	Northern California—
Whitewater River	Kern River	American River
Santa Ana River	Kings River	Yuba River
Sespe and Piru Creeks	San Joaquin River	Feather River
Owens River	Mokelumne River	Pit River

The plat on the preceding page shows a diagrammatic sketch of a project proposed by the Yuba Development Company on the North Yuba River, which is among the more comprehensive projects before the office. The plans serve well to illustrate the complexity of the proposed project, which will develop almost as much hydro-electric power as is now developed by the largest power company in the state. There are others of corresponding magnitude.

Naturally, even to keep the records of the Division clear, when projects of such magnitude are before it, requires a personnel of considerable engineering experience. Such comprehensive developments will add greatly to the wealth of the state but at the same time the effect on established conditions will be marked, and the results which will accrue to the future development of water for the other natural resources may or may not be beneficial.

The law authorizes the Division of Water Rights to see that the waters of the state are developed to best utilize the natural resources of the state. The Federal Power Commission is invested with still broader powers and is authorized to use its powers to prohibit any power development which does not fit in well with any ultimate ideal development of all the economic possibilities; that is, irrigation, mining, flood control and miscellaneous interests must and shall receive consideration.

The Federal Power Commission exercises its power on practically all of the power streams of California through ability to grant or to withhold right of way over public lands. The Division of Water Rights exercises its authority through its jurisdiction over the diversion of the waters of the stream. A grant of right of way by the Federal Power Commission would be worthless were the state to refuse a permit to divert its waters through a proposed conduit and likewise a permit to divert water would be inoperative if the permittee did not also have a right of way.

This condition of divided authority has necessitated and developed the closest cooperation between the Federal Power Commission and the Division of Water Rights. Almost one-quarter of all the projects filed before the Commission, and originating from all points in the United States, are in California. This has entailed an enormous amount of work, not only to state authorities but also to the local representatives of the Commission, and to the Washington office. This cooperation has materially simplified procedure before the two bodies and has expedited and harmonized action.

Simultaneous action has been expedited by a constant series of informal conferences between the two bodies. On some of the larger projects joint hearings have been held before representatives of the two offices. All parties in interest realize that this close cooperation exists and that every effort is being made by both organizations to avoid delay. Altogether seventy-eight projects from California have been filed before the Power Commission. This involves a vastly greater number of applications before the Division of Water Rights but these have been grouped into projects to correspond with the projects before the Federal Power Commission. Of these projects, nineteen are for various reasons not before the Division of Water Rights, being for transmission lines or having vested or riparian rights, fifteen have been given permits by this office, six have been canceled, and the remaining forty-eight have not yet been acted on, in most cases because the applicants have not yet finished the extensive surveys necessary to complete their applications. In addition to projects which are before both the Federal Power Commission and this Division, there are some forty or fifty in the preliminary stages before the Division but not yet before the Commission.

Most of the larger power developments embody extensive reservoirs in the headwaters of the streams, and because of increased summer flow made possible by these reservoirs, irrigation in the valleys will be benefited provided that works are constructed to smooth out the irregularities of flow incident to power operation. However, in some parts of the state the power reservoirs must be supplemented by reservoirs to recontrol the water for irrigation before this benefit can be fully operative. This hinges on the stage of development of irrigation up to the present time and the relative abundance of water as compared to the irrigable land.

This varies in different parts of the state. In northern California, that is, in the Great Valley north of San Francisco, the total annual flow is large compared to the area of land, therefore, any reservoirs which will increase the late summer supply will help irrigation. On the streams flowing into the Sacramento Valley, there are in few cases feasible large reservoirs low on the streams to re-regulate the discharge from the power plants for the demands of irrigation, but in most cases it is probable that regulation for power only will closely approximate the demand for irrigation of all the lands which can be irrigated from the streams on which the power projects are located, and thus that only minor regulation is necessary. An exception to this is the upper end of the main Sacramento River and on this, fortunately, there exists the Iron Canyon reservoir site which is now proposed as a part of the full development of the Sacramento Valley.

In this section of California there are considerable areas of foothill land susceptible of irrigation but the expense of development is so large that it has lagged. If power development goes ahead, the irrigation of some of these areas will be impeded because power will have acquired vested rights to the waters. Where any activity has been manifested in the irrigation of these areas, this has been helped as much as the law allows but it would be impossible and undesirable to hamper power development, which is needed now, for the benefit of possible future, but at present unplanned and unfeasible irrigation.

In Central California the San Joaquin Valley has large areas of land in excess of that which can be irrigated from the streams of the valley, and here the area of foothill land irrigated will be small. Some of these streams are very suitable to power development and the irrigated area in the valley is large. An irrigation practice has grown up suited to the natural flow of the river so that interference with the natural run-off by storage will in some cases upset existing practice. Fortunately, on most of the streams there are large and comparatively cheap reservoir sites in the foothills below the main power drops, and these when built can be used to regulate for irrigation the equated flow from the power reservoirs. The power reservoirs will supplement these larger reservoirs in controlling the streams. In some cases it has been necessary to refuse permits temporarily for storage to bona fide power projects until such time as the larger irrigation reservoirs below the proposed power plants have been constructed or some agreement has been reached. In these cases the power interests are keenly alive to the exigencies of the situation and have shown a helpful and cooperative spirit, realizing that the course adopted is for the best public interest. This situation exists on Owens, Kern and Kings rivers.



While the policy noted above is obviously one which protects and fosters irrigation, yet there are cases where power may suffer from certain phases of development of irrigation districts, and where the ultimate power possibilities can and should be protected. On some of the less favorable power streams in the San Joaquin Valley, reservoirs for irrigation are now being constructed or are proposed on the lower reaches for irrigation. These reservoirs will also be used to supply lowhead power plants and a vested right to the surplus waters of the stream will thus be acquired. Eventually demand will arise for power development above and this will be restricted by the vested right below which will inhibit proper regulation for power by means of upper reservoirs unless proper control is exercised in the initial stages.

In Southern California and in the Coast Range power will help irrigation. In Southern California water is used for irrigation during almost the entire year. The demand corresponds more closely, therefore, to the equated flow desirable for a power plant and while water is always insufficient it is to be expected that here the two will proceed hand in hand in the development of reservoirs, eventually without conflict.

Throughout the state these power reservoirs constitute an important feature of the ultimate flood control of the state. This is particularly the case in southern and central California. In central California the ratio of reservoir capacity which will be built for both power and for irrigation is large as compared to stream discharge and with proper regulation it will add measurably to the factor of safety which has been adopted by the Reclamation Board in its plans for flood control in the San Joaquin Valley.



## CHAPTER VII.

### WORK OF STATE DIVISION OF WATER RIGHTS ON KINGS RIVER.

By CHAS. L. KAUPKE, Water Master.

Kings River is one of the largest streams entering the San Joaquin Valley. It heads on the north slopes of Mount Whitney and is joined by several large tributaries giving the water shed a roughly fan-shaped outline and embracing about 1740 square miles, of which more than half is in the high Sierras. This region receives heavy snowfalls during the winter months, which melt but slowly, and consequently, in average years, the river does not reach its highest stage until the middle of May or first of June. The mean annual discharge is 1,900,000 acre-feet. Under the present conditions the mean annual diversion is 1,400,000 acre-feet resulting in a surplus of 500,000 acre-feet. A total of more than 45 canals, with an estimated capacity of 10,000 second-feet, divert from the river and irrigate 650,000 acres. The extent, variety, and value of the crops grown by means of the water furnished by this river give to it a rank second to none among the streams in the state.

About 20 miles east of Fresno the river debouches from the foothills of the Sierra Nevada Mountains and enters the Centerville Bottoms. These bottoms, which have a length of eight miles and an average width of three miles, are depressed below the general surface of the San Joaquin Valley plain about ten feet at the upper end and sixty feet at the lower end. The river flows through the area in several channels. The soil is very fertile and irrigation on Kings River was first begun here. Just below the bottoms the river is again confined in one channel and enters the "Reedley Narrows." The Narrows extend from a point about three miles north of the town of Reedley to the Southern Pacific Railroad crossing southeast of Kingsburg. The depth of the Narrows below the valley plain is 60 feet at the upper end and 10 feet at the lower end. The remainder of the river channel is in a flat alluvial cone.

Irrigation on the uplands or plains was first begun in the early seventies on the north side in the vicinity of Fresno and also west of Kingsburg, and on the south in the Hanford area. The bed of the river, outside the Reedley Narrows described above, being but little below the general level of the country, diversions were readily made at almost any point. The plain land being very fertile produced abundantly when irrigated, and rapid development resulted. Within the next ten years several large canals were completed and thousands of acres were irrigated.

The Rancho Laguna de Tache, a Spanish grant, commonly known as the "Laguna Grant," situated on the north bank of the river, in the vicinity of Laton, is the largest area of riparian land bordering on Kings River. For many years it was the source of great expense and annoyance to the canal companies and early settlers; nearly all the important canals were enjoined from diverting water from the stream. However, in nearly every case "a way out" was found and diversions were maintained and irrigation development extended. About 1892 the Fresno Canal (one of the largest on the stream) was purchased by

English capitalists and in order to improve their water rights these interests also purchased the "Laguna Grant." During the next few years most of the canal companies made compromise settlements with the owners of the "Laguna Grant," or in some other way adjusted their appropriation so as to avoid further strife and litigation on account of the riparian rights. However, litigation over riparian rights was by no means the only litigation over the waters of Kings River. As the country developed and the canal diversions increased the water supply was insufficient to give the settlers the quantities which they deemed necessary for their needs. Especially was this true with the late summer run, beginning about July 15th of each year. There was thus produced great and lasting animosities between the several communities of settlers and owners along the entire valley course of the river.

In the early development little attention was given to the matter of water measurement or to the amount of water diverted from the stream, and the measurement of flow and the length of time it was diverted by any given canal was very difficult to ascertain with any degree of accuracy. Each engineer or canal superintendent was responsible to the water users under his canal to see that their full supply was being diverted. Such a method, while satisfactory as long as the flow of the river exceeded the combined capacity of all the canals, developed endless disputes and friction during low water stages.

Most of the agreements and rights are based on the flow at Piedra, the U. S. Geological Survey gaging station above the highest irrigation diversion. The gage reading at Piedra is made and reported by the Weather Bureau at seven o'clock each morning, and diversions are made in accordance therewith until the next morning. During the spring months there is a large diurnal variation in the flow caused by the changes in the rate of snow melting, due to difference of temperature between day and night. The difference between the daily maximum and the minimum flow, in extreme cases, amounts to 50 per cent of the minimum at medium stages of the river. The maximum occurs in the morning and the minimum in the late afternoon or evening. As the official gage reading almost coincides with the maximum stage, when the river is affected by snow melting, the daily mean discharge is considerably overestimated. This condition is the cause of many of the difficulties encountered.

About the year 1900 a hydrographic survey was made of the Kings area by the U. S. Geological Survey, under the immediate supervision of Mr. J. B. Lippincott, as part of the general plan for ascertaining the water resources of the country, and the extent to which the arid lands could be redeemed by irrigation. The report was very favorable to the development of storage on Kings River. Two years later and immediately after the organization of the U. S. Reclamation Service, an appeal was made by certain public spirited citizens for federal aid. Mr. F. H. Newell, chief engineer of the U. S. Reclamation Service, responded and spent several months in endeavoring to establish cooperation and harmony between the many factions that had sprung up as a result of past litigation. But all efforts in this direction failed to accomplish the desired end and the Reclamation Service abandoned the project.

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English capitalists and in order to improve their water rights these interests also purchased the "Laguna Grant." During the next few years most of the canal companies made compromise settlements with the owners of the "Laguna Grant," or in some other way adjusted their appropriation so as to avoid further strife and litigation on account of the riparian rights. However, litigation over riparian rights was by no means the only litigation over the waters of Kings River. As the country developed and the canal diversions increased the water supply was insufficient to give the settlers the quantities which they deemed necessary for their needs. Especially was this true with the late summer run, beginning about July 15th of each year. There was thus produced great and lasting animosities between the several communities of settlers and owners along the entire valley course of the river.

In the early development little attention was given to the matter of water measurement or to the amount of water diverted from the stream, and the measurement of flow and the length of time it was diverted by any given canal was very difficult to ascertain with any degree of accuracy. Each engineer or canal superintendent was responsible to the water users under his canal to see that their full supply was being diverted. Such a method, while satisfactory as long as the flow of the river exceeded the combined capacity of all the canals, developed endless disputes and friction during low water stages.

Most of the agreements and rights are based on the flow at Piedra, the U. S. Geological Survey gaging station above the highest irrigation diversion. The gage reading at Piedra is made and reported by the Weather Bureau at seven o'clock each morning, and diversions are made in accordance therewith until the next morning. During the spring months there is a large diurnal variation in the flow caused by the changes in the rate of snow melting, due to difference of temperature between day and night. The difference between the daily maximum and the minimum flow, in extreme cases, amounts to 50 per cent of the minimum at medium stages of the river. The maximum occurs in the morning and the minimum in the late afternoon or evening. As the official gage reading almost coincides with the maximum stage, when the river is affected by snow melting, the daily mean discharge is considerably overestimated. This condition is the cause of many of the difficulties encountered.

About the year 1900 a hydrographic survey was made of the Kings area by the U. S. Geological Survey, under the immediate supervision of Mr. J. B. Lippincott, as part of the general plan for ascertaining the water resources of the country, and the extent to which the arid lands could be redeemed by irrigation. The report was very favorable to the development of storage on Kings River. Two years later and immediately after the organization of the U. S. Reclamation Service, an appeal was made by certain public spirited citizens for federal aid. Mr. F. H. Newell, chief engineer of the U. S. Reclamation Service, responded and spent several months in endeavoring to establish cooperation and harmony between the many factions that had sprung up as a result of past litigation. But all efforts in this direction failed to accomplish the desired end and the Reclamation Service abandoned the project.







The extremely dry years of 1912 and 1913 forced the people to see the urgent need for storage if any further development were to be made. A mass meeting was called and an attempt made to have the people from the whole Kings River area attend. The results were not especially encouraging, but an organization was formed for the purpose of obtaining cooperation among the many conflicting interests on the stream. After three or four years of effort by public spirited men of the community an organization was created containing representatives of all the important interests, including the canal companies and riparian owners. This does not mean that they were agreed as to their respective rights; in fact they were wide apart, but they had begun to see the necessity for arriving at an agreement if litigation were ever to cease and further development be accomplished.

With the enactment of the California Irrigation Act, this organization resulted in the Kings River Conservation District Executive Committee. The first real task before the committee was a settlement by agreement of existing rights, as the storage scheme contemplated that these rights should remain intact. Most of the low and medium stage water rights had been defined by court decrees, judgments and agreements, but no complete data were available showing to what extent diversion and use had conformed with the claimed rights. It was apparent that accurate records should be kept from year to year of all water diverted and that it would be desirable to have this work done by a state agency. A resolution embodying such a request was made at a meeting of the committee held in Fresno in October, 1917.

The State Water Commission responded and agreed to furnish the service of an engineer during the irrigation season of 1918, provided all of the appropriators or users of water would agree to cooperate in making complete measurements and records of all diversions.

The writer, as engineer for the State Water Commission, arrived in Fresno on December 27, 1917. The first step was to become familiar with the location and character of the various intakes. In this he was greatly aided by the officials and employees of the various irrigation companies. A number of canals were already equipped with gaging stations and most of the others immediately built stations in accordance with the request of the engineer. The Water Commission, through a cooperative arrangement, secured the use of twenty-one water stage recorders from the Bureau of Public Roads, U. S. Department of Agriculture, a sufficient number to place one on each canal to be measured and not already so equipped. With the coming of warm weather the number of canals diverting and the area irrigated increased rapidly.

Those canals diverting near the foothills have clean channels, permanent cross-sections, and relatively high velocities, and the ratings show very little change from year to year. On the lower river, canal gradients are very flat—in fact, in most cases less than one foot per mile. Raising or lowering a checkgate two or three miles down the ditch may have a noticeable effect on the rate of flow at the intake. At high stages of the river large quantities of sand are deposited in the upper reaches of the canals. In the late spring and early summer months, aquatic plants and tules grow abundantly, greatly decreasing the rate of flow. All these are factors in changing the rating. In one instance, no less than ten rating curves were used in a year.



Daily diversion records were kept during the year 1918 on the following canals: Alta, Gould, Fresno, Consolidated, Lake Lands, Peoples, Last Chance, Emigrant, Lemoore, Grant, "A", Island, Liberty, Turner-Riverdale, Little Mill Race, Big Mill Race, Reed, Crescent, Stinson, Beta Main, Jap, and Carmichael Slough. No satisfactory results were obtained on Beta Inside, Empire Canals Nos. 1 and 2, Blakely and Tulare Lake canals.

At the end of the calendar year 1918 the data obtained under the immediate supervision of the writer were compiled in a printed report by the Water Commission and copies were made available to all interested parties. It proved to be valuable information, as each appropriator, knowing how much water he had used, could form a fairly accurate estimate as to his requirements. The irrigation interests fully realized that this work was just what was needed and that it should be continued over a period of years. The agreement with the Commission was renewed and the work was continued through the year 1919.

The run-off during the year 1919 was considerably below the normal; in fact it was only a 58 per cent year. By the beginning of July there was not water enough to supply canals who were entitled to all of the low flow. This situation annually resulted in friction and disputes, which in recent years were greatly aggravated by personal animosities. These companies fully appreciated the necessity for giving to an unbiased and disinterested agency the authority to supervise the division of the water at low stages of the river. The State Water Commission, having through its local representative acquired the confidence of these people as to its integrity and ability, appeared as the logical agency to undertake the work. A meeting of the interested parties was called on July 28th, at which the chairman of the Commission presided. The engineer of the Commission was given authority to act as water master during the remainder of the year 1919, and to distribute to the canals entitled thereto the flow of the river up to the two thousand second-foot stage at Piedra in accordance with a schedule mutually agreed to.

This, however, was only a beginning. Engineers and others interested immediately set to work to extend the schedule. The reasons for this can be ascribed largely to the recognized need of settling all existing water rights on the stream prior to the construction of the proposed Pine Flat Storage project. Such a settlement had not been accomplished through fifty years of expensive court litigation, during the course of which 137 suits had been initiated. Several schedules were proposed, only to be rejected as unsatisfactory by one or more rival claimants to the water. Sentiment, however, in the meantime, had grown strongly in favor of adopting such a schedule. On October 18th a meeting was held, at which nearly all canal interests having established rights were represented. The meeting unanimously passed resolutions declaring itself in favor of agreeing on the adoption of a schedule of distribution, and placing its operation in the hands of a water master, acting under the authority and supervision of the State Water Commission. It was also decided that a working committee be selected, consisting of one member for each company. Plans of procedure were discussed, which led to the decision that each company present a tentative schedule of its rights, to serve as a basis for discus-



sion. The committee also went on record as desiring and requesting that the engineer of the Commission be employed for the year 1920 to carry on and continue his work and water measurements on Kings River.

Beginning with the year 1920, the scope of the work was considerably enlarged. Measurements were made and records kept of diversions on the lower river where no satisfactory results had been obtained heretofore. To furnish data especially desired by the Schedule Committee, measurements were made of diversions in Centerville Bottoms and of seepage losses and return waters from the river channel.

Much of what precedes is in a sense contemporary history and is given here briefly to show the sequence of events leading up to the most important step yet taken by the irrigation interests on Kings River, as regards a settlement of disputes on water rights—the adoption of the schedule agreement.

Several meetings were held by the executive committee, and the engineers and attorneys, who had organized themselves into a board of engineers, and board of attorneys, were busy on the work assigned to them, when it was announced that the riparian suits (*Stinson & Crescent vs. Lemoore*) were set for trial in October.

It was very apparent that if these suits came to trial, long and expensive litigation would result. No further progress on the organization of the storage project would be made in the meantime and the benefits of much of the valuable work already done would be lost.

At a meeting of the board of engineers, the gravity of the situation was discussed and a committee consisting of Messrs. J. B. Lippincott, L. A. Nares, and Chas. L. Kaupke, was appointed to prepare a tentative agreement to be made and entered into by all water users on Kings River. This agreement provided that pending litigation be postponed, that all water users submit arguments to the State Division of Water Rights (formerly State Water Commission), setting forth their claims to the waters of Kings River, and that the Division of Water Rights be requested to prepare a temporary schedule for the division and administration of the waters of Kings River for the year 1922. After being prepared by the legal department of the Division of Water Rights, it was resubmitted to the committee, the board of attorneys, and the board of engineers, and by them approved. Copies were then sent to each and every interest on the river with the request that it receive earnest and immediate consideration and also advising the recipients that a meeting would be held at an early date at which every interest claiming rights to the waters of Kings River would be requested to sign the agreement. The meeting was held on September 27, 1921. In less than two hours time thirty-five signatures were affixed, representing more than 95 per cent of the appropriations and an area of more than 1,000,000 acres.

The following is an abbreviated text of the agreement:

#### WITNESSETH:

That whereas, during the last twenty years the water users on Kings River have been endeavoring to reach agreements that would permit of the construction of the Pine Flat Reservoir for the conservation of the flood waters of Kings River, without successful accomplishment, the principal difficulty in connection therewith being the failure to agree on a schedule for the division of the waters. \* \* \* The

schedules that have been presented during the past few months have no fundamental or radical differences that apparently would justify failure to reach some final conclusion and it is, therefore, believed that some independent and impartial authority would have no serious difficulty in harmonizing them; and

Whereas, \* \* \* Said State Water Commission and Division of Water Rights have collected accurate and extensive measurements of the water of all the canals diverting water from Kings River during the past four years. Their records have been accepted as accurate and satisfactory; and

Whereas, in addition, the Division of Water Rights had at its disposal numerous other state records as to the duty of water and the areas irrigated. By agreement of the parties interested, this Division has had charge of the distribution of the waters of Kings River up to a flow of 2000 cubic feet per second, measured at Piedra, and this service has been satisfactorily performed. The Division of Water Rights as the successor of the State Water Commission is the agency contemplated under the law of the state as the proper authority to which to appeal for the distribution and administration of the streams of the state among water users; and

Whereas, \* \* \*

Now Therefore, the various canal organizations and individuals who are diverting water from Kings River, together with the owners of riparian lands thereon, in order to avoid litigation, strife and expense, and to accomplish a more just and effective distribution of the waters of the river to those entitled thereto, and to assist in the efforts for the construction of a storage reservoir on Kings River for the conservation of flood waters and the development of underground water supply by pumping, and in consideration of the premises and the mutual covenants herein contained hereby enter into the following agreement for the preparation of a temporary schedule for the division of the waters of Kings River and its administration for the calendar year 1922, and it is hereby agreed:

(a) That all corporations, districts, individuals and riparian owners, claiming rights to the waters of Kings River, submit arguments to the said Division of Water Rights of the Department of Public Works setting forth their claims to the waters of Kings River.

(b) That the Division of Water Rights be requested to prepare a temporary schedule for the division of the waters of Kings River for the year 1922.

(c) That this temporary schedule, which is to be prepared, may be varied by the Division of Water Rights to meet the requirements of different districts or sections of the area irrigated from Kings River for different seasons of the year.

(d) That the acceptance of this agreement binds the parties signing it to the acceptance of the temporary schedule to be prepared by the Division of Water Rights, but on January 1, 1923, any canal company, individual or riparian owner, claiming water rights to Kings River, who has signed this agreement, may withdraw by serving on said Division of Water Rights written notice of intention to withdraw, which notice shall be served on or before October 1, 1922. As to all parties who have not withdrawn as aforesaid, the schedule shall continue in force from year to year, but any party shall have the right to withdraw at the end of any calendar year by giving the three months notice as herein above provided.

(e) \* \* \*

(f) That the Division of Water Rights shall put a water master in charge of the river to interpret and administer the schedule and have control of the diversion works of the various canals.

(g) That any canal company, individual water users or riparian owner may appeal to the Chief of the Division of Water Rights from any decision of the water master, in which event all interested parties shall be notified by the Division of Water Rights so that they may be present at the hearing which shall be held by the said Chief of Division, and the decision of the said Chief of the Division shall be final.

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The Division of Water Rights accepted the task imposed upon it by this agreement, and after careful study of the evidence, arguments and

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DIVISION OF WATER RIGHTS  
DEPARTMENT OF PUBLIC WORKS  
STATE OF CALIFORNIA

SCHEDULE FOR DIVISION & ADMINISTRATION  
OF THE WATERS OF THE KINGS RIVER FOR THE YEAR 1922

KINGS RIVER AT PIEDRA	FRESNO	CONSOL- IDATED	ALTA	CENTER- VILLE	KINGS COUNTY CANALS	LAGUNA	MURPHY SLOUGA	EXPLANATION OF NAMES ON SCHEDULE	NOTES:	EXPLANATION OF NAMES ON SCHEDULE																		
AREA IN ACRES DISCHARGE-SEC.FT.	243900	155600	129300	100000	155670	370000	267000																					
1.00	70				70		15	15	FRESNO	CRESCENT Crescent Canal Company																		
2.00	100				170				Fresno Irrigation District	STINSON Stinson Canal & Irrigation Co.																		
3.00	100				320				Fresno And Gould Canals	BURRELL Cuthbert-Burrell Company																		
4.00	150								CONSOLIDATED	JAMES James Irrigation District																		
5.00	250								Consolidated Canal Co.	James Main Canal																		
6.00	350								Consolidated Irrigation Dist.	Jap Ditch																		
7.00	450								Island No.3 Irrigation Dist.	BETA MAIN Tranquillity Irrigation Dist.																		
8.00	550								ALTA	James Irrigation District																		
9.00	650								Alta Irrigation District	UPPER SAN JOSE Clarks Fork Riparian Acres																		
10.00	750								LAGUNA	HEINLEN Riparian Lands Not Covered By Lemoore Canal Stock																		
11.00	850								Laguna Irrigation District	EMPIRE Empire Water Company																		
12.00	950								Grant Island And A Canals	TULARE LAKE Tulare Lake Canal Co.																		
13.00	1050								LIBERTY																			
14.00	1150								Liberty Ditch Company																			
15.00	1200								EMIGRANT																			
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documents submitted, and the diversion records of the canals during the past four years by the Division of Water Rights, prepared a schedule and appointed the writer water master to administer the same.

As provided in section (b) of the agreement a budget, to the amount of \$15,000, covering estimate of cost of administering the schedule and work incident thereto, was submitted to the executive committee and unanimously approved. In prorating the assessment among the various water users the work was divided into two divisions, with one-half of the assessment allotted to each.

(1) Administration of the temporary schedule prepared by the Division of Water Rights for the year 1922.

(2) Collecting engineering data to aid in the permanent settlement of water rights and for the consummation of the Pine Flat Storage project. Under division (2) it is contemplated to obtain:

- (a) Complete records of daily diversions by all canals.
- (b) Division of water between North Fork and the South Fork of lower Kings River.
- (c) Flow into Tulare Lake and the San Joaquin River from Kings River.
- (d) Flow into Tulare Lake from other sources.
- (e) Return water studies.
- (f) Maintenance of automatic water stage recorder on Kings River at Piedra.

The assessments levied on the various irrigation interests have been promptly paid, thus providing ample funds to carry on the work. The water master perfected his organization as soon as the occasion demanded. Two assistants were employed soon after the beginning of the year: one with headquarters in Fresno and the other in Hanford. A gage observer was employed at Piedra, and telephone lines were extended which enabled the office to have reports of the gage reading on Kings River at that point twice daily, 6 o'clock a.m. and 6 o'clock p.m., and oftener if necessary. Automatic gages were installed on Cross Creek and Tule River. Superintendents, headgate tenders and other employees of the various canal companies made gage readings and regulated headgates and weirs as directed by the water master.

The schedule was rigidly administered from the beginning of the irrigation season until May 5th, and again from July 1st to the end of the calendar year. During the intervening period the river was in flood stage and the flow exceeded the combined requirements of the canals and little supervision was necessary. The water master and his staff, however, were exceedingly busy. Records were kept and engineering data obtained as outlined under (2). In addition to this, the reclamation districts on the lower river and grain growers in the Tulare Lake Basin area were daily advised of the stage of the river at Piedra and forecasts were made of any changes of stage of the river as it affected them.

At the time of this writing, near the end of the year 1922, the schedule agreement remains in full force and effect. Not one of the signers has seen fit to avail himself of the provision for withdrawing as provided in section (d) and in part as follows: "On January 1, 1923, any canal company, individual or riparian owner, claiming water rights



to Kings River, who has signed this agreement, may withdraw by serving on said Division of Water Rights written notice of intention to withdraw, which notice shall be served on or before October 1, 1922." For the purpose of furnishing complete information to the water users of this year's schedule operation, a report was prepared by the Division of Water Rights, giving the daily diversions by all canals, excepting those in Centerville Bottoms, the discharge of Kings River at Piedra, Elkhorn Grade and below Empire Weir No. 2, for the period of January 1 to July 31, 1922. The report was made available to all signers of the agreement in ample time to permit a careful study thereof prior to October 1st. The fact that no one has withdrawn is the source of much gratification to the Division of Water Rights, as well as to the signers themselves. It is evident that they believe the schedule, although not entirely satisfactory in its present form, to be a long step in the right direction, and that with some constructive revision it will ultimately bring about an amicable settlement of all water rights on Kings River, and thus prepare the way for the consummation of the Pine Flat Storage project.

## CHAPTER VIII.

### LOWER SAN JOAQUIN RIVER HYDROGRAPHIC SURVEY.

By HARRISON SMITHERUM, Assistant Hydraulic Engineer.

It is a matter of record from measurements made on the San Joaquin River at Friant and near Newman, over a period of years, that a large portion of the flow of the river runs to waste annually. Seeking to utilize some of these surplus waters for the irrigation of their arid lands, the proposed Madera Irrigation District in January, 1916, filed an application with the State Water Commission for the diversion of 5000 second-feet natural flow and 380,000 acre-feet annual storage of the waters of the San Joaquin River. In September, 1919, the proposed district filed another application for the diversion of 3000 second-feet natural flow and 500,000 acre-feet annual storage. Additional large filings were made by other interests. Little or no data were available as to actual diversions and it was deemed necessary that an investigation of the various diversions and use of water be made.

Such an investigation was also necessary to the Madera Irrigation District itself and on its organization, early in 1920, the district sought the cooperation of the State Water Commission, with the result that in June of that year a contract was entered into by which the District provided funds for a hydrographic investigation by the State Water Commission on the San Joaquin, Fresno and Chowchilla rivers. While the major part of the expense of the investigation has been provided by the district, the Division of Water Rights has also contributed a comparatively minor amount to the work.

#### Scope and Purpose.

The investigation was to deal principally with the main San Joaquin River, including its mountain drainage area and the San Joaquin Valley portion to the lower end of the valley, together with the two tributaries, Fresno and Chowchilla rivers. Measurement and study was proposed as follows:

- (1) Flow in main San Joaquin, Fresno and Chowchilla rivers.
- (2) Diversions from above named streams.
- (3) Present use of water for irrigation.
- (4) Effect on irrigation of release of storage water from power reservoirs.
- (5) Return flow from irrigation in the main San Joaquin, Merced, Tuolumne and Stanislaus rivers.

#### Cooperation.

In addition to money provided as just noted, both the District and the Commission have supplied water stage registers for the work. The water resources branch of the Geological Survey and the interests using waters within the area investigated have cooperated in establishing measuring stations and furnishing available records. Acknowledgment is made for information received and courtesies extended by the officials and employees of these interests.

Field work on the investigation began June 11, 1920. After a reconnaissance of the territory to be covered it was realized that

with the funds available, the nature of the country to be traversed and field conditions to be met precluded various phases of the work as outlined and it was decided that the major portion of the field work must be in the valley section and would be confined to the ascertainment of the discharges of the above mentioned streams and diversions therefrom.

The measurement of gravity diversions has been confined to controlled diversions, because of the number and character of outlets and the adverse physical conditions existing at many of them. The determination of the duty of water over the areas served by means of the measured flow at the intakes of canals is impossible, due to interchange of water between canals. These conditions are found only on the San Joaquin River and will be discussed later.

In addition to the measurement of the controlled gravity diversions from the streams in question, measurements on the San Joaquin River near Newman, in cooperation with the water resources branch of the Geological Survey, the Merced River near Livingston, the Fresno River at Madera, and the Chowchilla River above Buchanan, have been made. On Plate 9, page 66, will be found a map showing the territory covered by this investigation and the various diversions and measuring points.

#### SAN JOAQUIN RIVER.

The San Joaquin River, with a mean annual flow of 2,000,000 acre-feet at Friant and a drainage area of 1640 square miles, is the second largest stream of the valley.

Entering the plains below Friant, it flows southwesterly to the point of confluence with Fresno Slough and thence northwesterly to Suisun Bay. In its course to Suisun Bay the flow is greatly increased by many important tributaries draining the western slopes of the Sierras. During periods of peak run-off, the flow is further increased by an uncertain overflow from the Kings River watershed, entering through Fresno Slough. Tributaries from the west side are of little importance.

At Friant the river is shut in by bluffs, but it soon enters the low flood plain of the valley and at that point Gravelly Ford Canal diverts.

"The surface of the valley is in brief a combination of the surface of a great number of alluvial fans originating at the mouths of the canyons, through which the tributary streams discharge from the mountains into the valley."

"Each stream that enters the valley brings with it from the mountains a greater or smaller quantity of sand, gravel, or boulders. All or a part of this burden is deposited in the valley and the deposit constitutes the alluvial fan of that particular stream. The apex of each fan is the mouth of the stream canyon. From this apex it broadens and flattens until it coalesces at its periphery with other fans. The stream that built the fan usually spreads delta wise over it, discharging through a number of diverging channels into the trough of the valley." (U. S. G. S. Water Supply Paper No. 299.)

That portion of the San Joaquin Valley where are met the major problems of this survey lies wholly within the low flood plain of the river and its various tributaries. The stream is confined by low banks and cut by numerous sloughs, which, after running for a distance in



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That portion of the San Joaquin Valley where are met the major problems of this survey lies wholly within the low flood plain of the river and its various tributaries. The stream is confined by low banks and cut by numerous sloughs, which, after running for a distance in







the same general direction as the river, reunite with it forming a broad swampy area which is often submerged. Canals, dams, levees and irrigation systems within this area have served to reclaim extensive areas. Other large areas of undeveloped or only roughly developed wild grass pasture lands still remain that are subject to inundation through river and slough outflow, together with water from controlled diversions.

Roughly, this flooded area extends along both sides of the river between the Aliso Canal and the mouth of the Merced River, except for that portion on the west side of the river between Mendota Dam and a point two miles above the head of Pick Anderson Slough.

Diversion points within this area are accessible only over difficult roads, which grow worse as the river rises. At flood stages these diversions can be reached only by boat or by horse drawn vehicle, the latter a hazardous undertaking without intimate knowledge of the country.

Between the Gravelly Ford Canal in section 8, T 13 S., R 17 E., and the mouth of the Merced River, many of the sloughs have been controlled and have become parts of irrigation systems. Others, while uncontrolled, are important factors in the irrigation of wild pasture lands. These, together with the artificial canals cut into the banks of the river, constitute the gravity diversions from the San Joaquin River.

There are fifteen gravity diversions controlled by structures; more than twenty uncontrolled sloughs, which take water at various stages of the river; innumerable small sloughs and overflow channels taking water only at extreme high stages; and all these divert from the San Joaquin River in that portion of its course between the Gravelly Ford Canal and the mouth of the Merced River, a distance by river of approximately eighty miles.

#### **Problems Encountered.**

The uncontrolled sloughs along both sides of the river present many difficulties of measurement. Diversion points are not readily accessible and a large portion of the water diverted is returned to the river. Many of the sloughs divert water from, or return water to, the river depending on the stage of the river and depth of inundation of the surrounding country. The areas served by these diversions are unprepared or only roughly prepared wild grass pasture, which are also subject to overflow and may receive return or waste water from controlled diversions. These latter present no unusual problems in the measurement of amounts diverted other than the difficulty of obtaining entirely satisfactory records of daily discharge which difficulty is due to operation of check gates below gaging stations.

The East Side Canal is an exception to the above. Due to numerous waste gates between the intake and Bear Creek, to provide for the passing of water diverted by uncontrolled sloughs and river overflow, it was necessary to locate the measuring station on the canal just above the Stevinson Colony. During flood stages of the river the canal may be supplied entirely by this cross-country water.

The areas served by these diversions consist both of lands cultivated for alfalfa and annual crops, and lands flooded and swamped for wild grass hay and pasturage or for reclamation from alkali. These areas are

held in large tracts, owned by the interests controlling and operating the diversions.

Within the cultivated areas on the west side of the river, there is a complicated interchange of water between canal systems; the lower diversions receive waste water from irrigated areas supplied by higher diversions, and areas served are extensive and irregular in shape, making determination of duty impossible.

The wild grass lands served by the controlled diversions lie principally on the east side of the river. These areas are at best only roughly prepared for swamping by high check levee systems. The areas actually receiving water can be determined only by detailed surveys. The waste and return flow from this swamp irrigation is large, but because it is returned to the river in the same channels with water diverted by uncontrolled sloughs and river overflow it is unmeasurable.

The canals serving this area divert from the river and run north across the trough of the country. There is much interchange of water between canals together with water diverted by uncontrolled sloughs and river overflow. It is not uncommon, during flood stages of the river, for the headgates on lower diversions to remain closed, the canals being supplied entirely by an upper diversion or by a combination of return flow from swamp irrigation, overflow from the river and water diverted by uncontrolled sloughs.

The determination of the duty of water under these conditions is impractical.

#### Measuring Stations.

Three gaging stations valuable to the investigation are maintained on the San Joaquin River by the United States Geological Survey: one at Friant, one near Newman, below the mouth of the Merced River, and one below the mouth of the Stanislaus. The latter station was established in 1922 for the measurement of return flow from irrigation. A measuring station on the river at the head of Lone Willow Slough is maintained jointly by the San Joaquin Light and Power Corporation, Southern California Edison Company, and Miller and Lux, Incorporated. This station is used principally as a control station for the release of stored water from power reservoirs and for the allotment of water to the canals having the first rights on the river, namely, the San Joaquin and Kings River Canal and Irrigation Company's main canal, and the Chowchilla Canal. The station is of little value during flood flows due to overflow of river banks above the station.

#### Diversions.

At present there are fifteen controlled gravity canals and sloughs and ten major pumping plants diverting from the San Joaquin River, named in their order down stream as follows:

- (1) Gravelly Ford Canal; (2) Aliso Canal; (3) Browns Slough;
- (4) Lone Willow Slough, Columbia Canal, Chowchilla Canal; (5) Herminghaus Slough and Mowry Canal; (6) Tranquillity Pump No. 1, Fresno Slough; (7) Tranquillity Pump No. 2, Fresno Slough; (8) Firebaugh Canal Pump; (9) Outside Canal; (10) San Joaquin and Kings River (Main) Canal; (11) Helm Canal; (12) Helm Ranch Ditch; (13) Blythe Canal; (14) Temple Slough; (15) Santa Rita



Slough and Pozo Extension Canal; (16) Siphon Slough; (17) East Side Canal; (18) San Luis Island Canal; (19) Patterson Water Company; (20) El Solyo Ranch; (21) Whitehall Estate; (22) Naglee-Burke Irrigation District; (23) West Side Irrigation District; (24) Byron-Bethany Irrigation District; (25) Knightsen Irrigation District and East Contra Costa Water Company.

The diversions in the San Joaquin delta have not been considered within the scope of this survey and have not been investigated.

### FRESNO RIVER.

The Fresno River with a drainage area of 272 square miles heads in the low Sierras. Dependent upon rainfall for its water supply, the flow is intermittent, and without storage very undependable for irrigation. The important flow occurs between the months of December and June. The bed of the stream is practically dry during the remainder of the year.

#### Measuring Stations.

At present there are two gaging stations on the Fresno River, one near Knowles, maintained by the United States Geological Survey, and one at Madera, maintained by the Division of Water Rights.

#### Diversions.

There are three canals diverting from the Fresno River, namely: Madera Canal and Irrigation Company, Stockton and Bonita canals. The Madera Canal and Irrigation Company serves from 8000 to 10,000 acres annually. The Stockton and Bonita canals are used to irrigate lands on the Bonita and Monte ranches owned by Miller and Lux. The Stockton Canal is used to flood wild pasture land, while the water diverted by the Bonita Canal is used for the irrigation of alfalfa.

### CHOWCHILLA RIVER.

The Chowchilla River, draining an area of 268 square miles, is similar in origin and flow to the Fresno River. It flows in a south-westerly course along the northern boundary of Madera County and thence northwesterly to its junction with the San Joaquin. About ten miles below Buchanan the stream forks into three channels: Berenda Slough, Ash Creek and Chowchilla River. During the season of maximum run-off, Ash Creek and Berenda Slough carry the bulk of the flow. The Chowchilla River by means of temporary dams across the bed of Ash Creek carries the entire low water flow.

#### Measuring Stations.

Three stations are maintained on Chowchilla River by the Division of Water Rights: one in the foothills above Buchanan, the others above and below Sierra Vista Ranch, respectively. The two latter stations are used to determine the water diverted by the Sierra Vista Ranch. Being located below the forks of the stream the measured flow at these stations is not comparable to the flow above Buchanan, except during periods of low flow.

### **Diversions.**

Aside from wild grass irrigation by flooding practiced on the lower reaches of the stream, the only irrigation system on the Chowchilla River is that of the Sierra Vista Ranch near Minturn.

### **WORK DONE.**

#### **Progress in 1920.**

June and July were spent in a reconnaissance of the territory and in making intermittent current meter measurement on the various canals and streams within the scope of the investigation. Following the reconnaissance, automatic water stage recorders were installed at the previously selected points on the main diversions as rapidly as possible, and by November 1st twelve such stations were established. Included among these were the five canals diverting water at that season of the year. Three diversions, namely, Henninghouse Slough, Santa Rita Slough and Siphon Slough, presented unfavorable conditions for obtaining continuous records and were not equipped with measuring stations.

Current meter measurements were continued throughout the year on the canals and return flow measurements made on the main San Joaquin and several tributaries.

The results of these measurements are available through the Division of Water Rights in a report entitled "Report of San Joaquin River Hydrographic Survey for 1920."

#### **Progress in 1921.**

During 1921 water stage registers were installed on all gravity diversions at previously established measuring stations as soon as the canals began to divert, and a continuous record was kept throughout the year. Current meter gagings were taken on all canals as often as possible, the average being one gaging per week on each canal, to establish station rating curves. In general the canals and sloughs have low gradients and the rating stations are affected by the operation of check gates and the ponding of overflow water below the stations, making frequent measurements necessary.

Measuring stations equipped with staff gages were rated and maintained on Fresno River near Madera, on the three canals diverting from the Fresno River, on the Chowchilla River above and below the Sierra Vista Ranch, and on the Merced River below Livingston.

In addition to the above, measurements were made on the San Joaquin River near Newman in cooperation with the United States Geological Survey, on the lower Merced in the study of return flow and on miscellaneous diversions and tributaries not equipped with rating stations.

The results for 1921 are embodied in a report entitled "Report on San Joaquin River Hydrographic Survey for 1921."

#### **Progress in 1922.**

The work during 1922 has been similar to that of 1921.

The measuring stations on the Fresno River, Fresno River diversions, and Chowchilla River, were equipped with water stage registers. Additional stations, equipped with water stage registers, were established on the Chowchilla River above Buchanan and on the San Joaquin and Kings River Canal (Main) one mile below the head. The station on the lower Merced was replaced with a cable station, equipped with a water

stage register, some four miles upstream from its former location at Milliken Bridge. In August an additional water stage register was installed on the Merced River near the mouth for the measurement of return flow from irrigation.

It has been possible, as noted above, to gradually enlarge the field of the investigation during successive seasons. At the same time the accuracy and general reliability of the work has also advanced, the whole without materially increased expense. These results have been brought about through greater efficiency of the engineering staff made possible mainly by close personal contact and familiarity with the numerous problems recounted earlier.



## CHAPTER IX. LEGAL DEPARTMENT.

### Character of Work Performed.

The legal work of the Division of Water Rights has grown steadily with the increasing volume of work handled by the Division, until the full time services of an attorney have become necessary. Legal advice is constantly required in connection with every activity of the Division. Questions of great variety and complexity are continually presented by applications filed before the office. Every case referred from a Superior Court involves legal advice and assistance to the Division in fulfilling its function as a referee and each stream system adjudication undertaken has its legal problems for solution. Frequent oral advice is called for by engineers of the Division relative to legal considerations both procedural and substantive; perplexing details of office administration and procedure constantly arise, necessitating interpretations as to the scope and meaning of provisions of the "Water Commission Act," which act has received practically no interpretation by court decision; written opinions are filed on questions of especial importance; contracts are drawn; official orders, certificates, and forms are prepared; conferences and hearings are attended in behalf of the Division; appearance is made in court when necessary; assistance is rendered in the preparation of stipulations for the settlement of water disputes; legal correspondence is conducted by the attorney; and letters, submitted by people from all parts of the state, seeking information relative to the law applicable to water rights and claims, are answered.

California water law is especially difficult of ascertainment due to recognition of both riparian and appropriative rights. The Water Commission Act throws light upon the doctrines of appropriation, but there is no act defining riparian rights and the law relative to both riparian and appropriative rights can be approximated only after reference to numerous court decisions, which are often apparently conflicting in terminology as well as in result. This situation is responsible for a heavy demand for information general and specific on the subject of water rights, and though many of the inquiries made are not clearly within the jurisdiction of the Division, they are, nevertheless, answered and as definitely as possible whenever the Division believes it can be of service in assisting to clear up a water problem. Many intricate questions arise upon which opinion can be given only after careful study.

Legislative reforms and provisions needed are from time to time noted and drafted for enactment. In 1921 bills were presented before the legislature for the purpose of strengthening weak points in the "Act" and making the law more adaptable for service to the water users of the state. These defects come to light only as problems arise. At the next session of the legislature additional changes will be proposed by bills drafted to increase the efficiency of the Division in accomplishing its work.

On large stream systems a problem of practical difficulty remains after water rights have been decreed. Actual distribution of water in times of scarcity necessitates accurate apportionment and fluctuating stream flow demands vigilant head gate adjustment. Obviously one

management is essential to prevent mistake and insure fair play. Also, a decree can only be successful as it is administered. In view of the importance of this work and the increasing demand therefor a study of water master control in other states has been undertaken and is in course of progress with the purpose of formulating any additional legislation on the subject that may appear advisable.

In the above it has been attempted to set forth in a general statement the work conducted by the legal department of the Division and no attempt has been made to go into a detailed review which could be made to occupy many pages and which would not be appropriate in this report. Briefly the work of the legal department along the lines above indicated is increasing along with the volume of work transacted by the Division. This increasing activity is commensurate with the ever growing demand for water and the keener contention for its acquisition and control and for safeguarding rights claimed.

#### **Opportunity for Settlements Out of Court.**

As a disinterested body with the means of ascertaining the essential facts of a case without a tedious hearing the Division is able to bring together litigants and prospective litigants where a court with its more formal procedure would fail. In the past, parties in interest or their attorneys and Division representatives, usually the chief, an engineer and the attorney, through the medium of an informal conference, have been able to gather around the table and in the light of facts ascertained by the Division, arrange a settlement by stipulation or agreement. This work has been accomplished with considerable satisfaction to all concerned and with a saving of time and expense that has been very appreciable. A day of conference may save a week of trial and reach a more desirable and final result. This valuable service has been rendered many water claimants, as witness such instances as the San Pedro Creek reference from the Superior Court of San Mateo County and the North Fork of Cottonwood Creek reference from the Superior Court of Shasta County and the Hat Creek reference from the same court which is in course of settlement by stipulation. This method of procedure is also frequently employed to dispose of protested applications and contests arising in the course of adjudication work.

#### **The Tulare Case.**

On July 6, 1915, the Tulare Water Company filed an application to appropriate 2000 cubic feet of water per second from Kern River flowing through Buena Vista Slough. September 26, 1919, the executive member of the State Water Commission entered an order rejecting the application, and December 17, 1919, the Commission as a whole affirmed this order of the executive member, which was based upon the conclusion that there was no unappropriated water. The Tulare Water Company thereupon applied to the Superior Court for a writ of mandate. The Superior Court sustained a demurrer to the complaint and held that mandate did not lie. Upon appeal the District Court of Appeal reversed the court below and directed that the demurrer be overruled (34 Cal. App. Dec. 987). Upon hearing before the Supreme Court the trial court was directed to overrule the demurrer and hear the cause on the merits. This decision of the Supreme Court was rendered December 12, 1921, and since that date no action has been

taken by the Tulare Water Company to set the case for trial on the merits. The decision is reported in Volume 187, California Reports, at page 533.

Since the publication of the Tulare case decision a broadcast impression has spread throughout the state which has been frequently and lustily voiced to the effect that the "wings of the Water Commission have been clipped," and that the Division of Water Rights as successor to the State Water Commission has been confined within a narrow field of activity. This impression is without foundation in law or in fact and is based upon the idea that all applicants are entitled to permits, that upon the refusal of a permit an applicant may receive a writ of mandate for the asking, only showing an application in due form, and so compel the issuance of a permit, and that the Division of Water Rights has been deprived of discretion and reduced to a perfunctory organization, a recording office for applications and permits.

The Tulare decision was rendered upon appeal from a ruling on demurrer. The petition alleged facts which established an application in due form for beneficial use and alleged unappropriated water. The demurrer admitted the facts pleaded and therefore admitted that the application was in due form, that it was made for a beneficial use, and that there was unappropriated water. The contention of defendant was that a Water Commission decision was final and that mandamus therefore did not lie. The Supreme Court decision negatived this contention. It in effect said that if the Superior Court upon evidence submitted should find that the application was in due form, that it was made for a beneficial use and that there was unappropriated water it should issue a writ of mandate directing the Water Commission to issue a permit. And the Supreme Court therefore overruled the demurrer and directed that the Superior Court hear the evidence as to existence or non-existence of the facts pleaded and admitted by demurrer.

But the Tulare decision does not deprive the Division of the right to investigate and compile data and hold hearings and ascertain the existence or non-existence of unappropriated water and to decide according to its findings of fact; it does not hold that an applicant upon presentation of an application duly executed and in form is entitled to a permit as of right; it does not hold that the presence of unappropriated water is not essential to secure a permit; it does not decide that writs of mandate are available without proving the existence of those facts which entitle a complainant to a certain action by an official body; it does not command the Division to issue a permit; it does not disturb the order rejecting the application of the plaintiff water company.

As to the instant case the decision merely disposes of the demurrer and opens the way for a trial on the merits. It remains for the Tulare Water Company to prove the pre-requisite facts and the Division of Water Rights contends that at least one essential fact does not exist, to wit, unappropriated water.

That the Tulare decision could not reduce the Division of Water Rights to a perfunctory existence can not be disputed for that decision has no relation to two out of three important divisions of work handled by the Division, to wit, stream system adjudication of all appropriative rights involved, and determination by court reference procedure of all water rights whether riparian or appropriative.



That the Tulare decision has not even reduced the Division of Water Rights to a perfunctory existence as regards jurisdiction over applications, is evidenced in the following paragraphs:

The Appellate Court in its decision declared it to be the duty of the Commission to investigate and determine and upon finding no unappropriated water to reject an application, as witness the following language:

“When an application is filed for the appropriation of water of a stream it is incumbent upon the Water Commission to approve the application if it fully complies with the provisions of the act and the necessary facts exist—that is to say, that the water applied for is unappropriated and subject to appropriation and that it is intended to be used for beneficial purposes.”

*“But it is not the duty of the Water Commission to approve every application which is in the prescribed form. As it is only water that is subject to appropriation, or is unappropriated, that may be applied for under the act, the commission must investigate under section 10 of the act, and determine whether the water applied for is in fact subject to appropriation or is unappropriated. If any of the essential facts necessary for the approval of the application are wanting, it is the duty of the Commission to refuse to approve it. But neither the approval or rejection of an application is a final judgment reached after a hearing and determination of the question involved.”*

The Supreme Court did not negative the expression above quoted from the Appellate Decision and the Supreme Court decision is authority only on the point at issue, to wit, whether on facts pleaded and admitted by demurrer (an application in due form, unappropriated water, beneficial use) a writ of mandate lies.

The application stands rejected today months after the decision. Were a writ of mandate issuable upon merely showing an application in due form certainly the company would have asked for it. This long delay seems to indicate the interposition of legal obstacles between the Tulare decision and a writ, and one chief obstacle, it is maintained, is the proof of unappropriated water.

The Division of Water Rights has continued to function without hindrance, and as extensively, vigorously, and efficiently as ever did the Water Commission. Its investigation work towards determination of existence or non-existence of unappropriated water in connection with applications to appropriate continues and the evidence resultant from such work will assist in reaching a correct final determination in such cases as may be reviewed by the courts. Also, the value of such technical investigation of purely physical problems is everywhere admitted and this very work in nearly all cases satisfies applicants whose applications are rejected, because the water applied for does not exist.

In conclusion it is here pointed out that as a matter of law the Division of Water Rights has not been restricted in scope of operation and that as a matter of fact no determination of the Division has yet been reversed and that though its determinations are subject to review we are not for that reason impotent. Court decisions are also subject to review by higher courts.

## CHAPTER X.

### UNDERGROUND WATER DEVELOPMENT.

The general subject of underground water and its great and increasing importance in California needs no comment, as the trend of development in this direction is well known. With the tremendous increase in pumping from ground water in recent years, however, a series of new problems, both physical and legal, have been encountered, and with the solution of these problems the Division of Water Rights must necessarily be intimately connected.

The conflicts arising over the ownership and use of water flowing on the surface of the ground can be, and have been in many cases in California, most distressing and injurious to the best interests of the state. Here, the physical facts can be directly ascertained. How much greater then is the possibility of misunderstanding or conflict over the use of an underground supply, where the facts are always obscure and in some cases not susceptible of close determination.

The question of how to proceed with the fullest possible utilization of the remaining underground sources of supply without a repetition of the earlier conflicts over surface rights or possible loss of capital through ill-advised projects is occupying the attention of many individuals and concerns in this state at the present time. This is particularly true in the southern part, where, most surface supplies having been appropriated many years ago, later projects have been forced to depend on the underflow for their water supplies. This chapter will be devoted to a discussion of the more recent problems brought to the attention of the Division.

By far the greater part of the use of underground water for irrigation has come about since 1899. In the decade since 1909 the increase has been specially marked and two-thirds of the 868,000 acres so irrigated at the time of the last census has been developed in the last ten years.

The following table, taken from data gathered by the United States Census Bureau, shows for the last three census dates the total acreage irrigated in the state as compared with the total irrigated by pumping from underground sources. It is especially noteworthy that while in the last decade the total irrigated area has increased fifty-four per cent the area irrigated from underground water has increased two hundred and fourteen per cent, almost exactly four times as fast. It is also noteworthy that while in 1909 only ten per cent of the total area was irrigated from underground sources, this had increased to twenty-one per cent in 1919.

TABLE 6.  
Increase in Irrigated Acreage in California.

Year	Total acreage irrigated	Acreage irrigated from underground sources
1899	1,446,000	153,000
1909	2,664,000	277,000
1919	4,095,000	868,000
Increase	Per cent	Per cent
1909-1919	54	214

The subject must be considered in both its physical and legal aspects. In a surface water problem the physical facts, while often intricate

and difficult to obtain, can after all be obtained with sufficient accuracy, and it is the awkward and involved legal situation involving the opposing doctrines of prior appropriation and of riparian rights, that creates the most serious obstacles to harmonious development. With underground water the case is exactly the reverse. The physical facts can be approximated only with great difficulty while the legal situation on the other hand is comparatively clear.

#### Legal Aspects.

As laid down by the courts, the rule governing the use of underground waters is, briefly, that a natural ground water supply is a common benefit for all overlying lands, and that each land owner is entitled to a reasonable use from this supply in common with all other overlying land owners. Use of the ground water supply is also allowed on distant lands when there is a surplus over and above the reasonable use of the overlying land owners.

It will be seen that the above rule allows a wide use of the underground water supplies, and does not restrict it to a few fortunate individuals owning land along a stream, as does the riparian doctrine. It affords the basis for the orderly development and distribution of all such sources of supply, which development as indicated by the figures quoted, is increasing rapidly, and is of the greatest importance to the progress and prosperity of the whole state.

This rule of the courts has not, however, been followed by delegating definitely to an administrative body the duty of applying its admirable principles. The Water Commission Act, under which the Division of Water Rights functions, states in section 42 in part as follows:

“Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels”.

This definition is not at all clear legally, and it is manifestly impossible for the Division, when receiving applications, to investigate each case and determine whether or not the water applied for is “flowing through known and definite channels”. It is the practice of the Division to notify parties desiring to file applications for underground water of the limitations of section 42 and to further advise them as follows:

“It is therefore unnecessary to apply if the waters to be developed are merely percolating waters. The Division of Water Rights advises, however, that application be made even in the case of percolating waters developed on the public domain (by boring wells, driving tunnels, or other methods) so that the applicant may have a stronger ‘record protection’ in case conflict later arises with others who enter the public land upon which the development is situated”.

If, after receipt of this letter, the party still desires to file an application, it is accepted and filed in the regular manner and acted on in due time. Large numbers of such applications have been received, indicating a general desire for state supervision of underground water supplies.



### Physical Aspects.

The impression prevailed generally in the past, and still persists to an unfortunate extent that the supply of underground water is inexhaustible, on account of the great depth and extent of some of the underground basins. It is clear, however, that over a period of years, no more water can be drawn out of the ground than goes into it, without a gradual lowering of the level of the water surface, and an eventual depletion of the basin.

The amount of water being supplied to the underground basin each year, or annual replenishment, is the first item to be taken up in the technical investigation of a ground water situation. This replenishment consists mainly of the percolation from the channels of the stream or streams traversing the basin. To obtain the amount of the percolation necessitates stream measurements of great accuracy, since it is often but a small percentage of the total flow. Inaccuracies may be introduced by the fact that there are other sources of replenishment than percolation from the stream beds. Such sources might be direct accretion to the ground water from rainfall on the basin, from flood run-off of minor streams and gullies, which as a practical matter are unmeasurable, return water from irrigation of overlying land, supplies from inter-connected adjacent basins, etc.

The amount of water withdrawn from the basin, or the annual draft, must also be obtained. This consists first of the direct draft by pumping for irrigation and domestic use, which is readily ascertainable. Springs, swamps or artesian wells may be the cause of additional drafts. Evaporation from the surface of the ground or from swamps is difficult to estimate accurately, but may be the cause of a large loss from the underground supply, and finally, if the basin is not of the "closed" type, that is, if there is an underground outlet to a lower basin or to the ocean, a very large draft may exist which it may not be possible to directly measure.

By the above it is not meant to convey the impression that it is impossible to ascertain the physical facts regarding underground water. This is not the case, for it is possible in each case to secure data sufficiently accurate for the purpose in mind. However, such data to be of value must be the result of a painstaking and intensive investigation, which often must extend over more than one season. The Division of Water Rights and its predecessor, the State Water Commission, have directed or assisted in several such investigations, all of which have been successful in obtaining the desired data. One of these investigations was carried on by the Commission for three years at an expense of \$30,000, and included probably the most complete study ever made of an underground water situation. It was possible at the conclusion of this study to closely balance the replenishment against the draft, the basin being of the closed type, and to evolve the relation between the amount of water flowing in the stream and the percolation therefrom. The work resulted in an agreement whereby it was possible to proceed with the construction of a large reservoir on the headwaters of the stream.

Summarizing the above statements, the law of underground waters is in conformity with the needs of the state, allowing full development.

Administration and direction, however, are lacking. The physical facts can be determined by proper investigation.

#### **"Spreading" of Storm Waters.**

The topography and climatic conditions in the southern portion of the state have resulted in the development of a method of conservation of water in that section which is relatively new in the art of irrigation. Surface storage of flood waters has been known and practised the world over for a long time. Underground storage of these waters and their recovery by pumping or by gravity, at the lower end of a subterranean basin, was brought about by demand for water and the lack of feasible surface reservoir sites.

The slopes of the stream channels are steep, making available surface storage very expensive. The run-off is flashy, the variation between normal summer flow and mean annual flow being exceedingly large, and the variation between wet and dry years such that excessive reservoir capacity is needed to furnish hold-over storage, when anything like the entire run-off of the stream over a long period of years is to be conserved.

The lack of available surface storage sites has been compensated for in a measure by the deposition in the stream beds themselves of alluvial material, and the formation at the mouth of the streams of debris cones. Flood water is readily absorbed in these cones under natural conditions. Much of the low flow of the streams in the summer time is maintained by the gradual draining out of the alluvial deposits saturated by the flood flow of the preceding winter.

The spreading of flood waters developed because the draft from various basins had become larger than the natural replenishment. As the name implies, the flood waters are spread by artificial means over a larger surface of porous ground than the stream would naturally occupy. The results obtained have been gratifying.

The most notable example of such spreading is that of the Water Conservation Association on the upper Santa Ana River. The association, composed of the various water and ditch companies diverting water from the Santa Ana River, assisted by the counties interested, has been very active in spreading and sinking the flood flows of the river on the upper debris cone of the river near Redlands. Accurate records of the amounts spread each year have been kept since 1912, and show the maximum to have been 82,000 acre-feet in 1922, and the minimum to have been 3000 acre-feet in 1913. A comparison of well levels in the San Bernardino Valley covering the period 1911-1921 proves conclusively that the spreading has resulted in raising the average well levels in the valley from ten to twenty feet. The cost of such spreading is said to be about fifteen cents per acre foot. The operation has proved so successful that the Association has lately applied to the Division of Water Rights to appropriate 150 cubic feet per second in addition to the original filing for 240 cubic feet per second, making a total of 390 cubic feet per second, or 19,500 southern California miner's inches, to be diverted.

A number of other applications have been received by the Division for the appropriation of water for spreading purposes. The applicants desire to spread storm waters and thereby raise or maintain the

ground water levels in many southern California basins. Among these are the San Jacinto, Perris, Coachella, San Bernardino, Antelope, San Fernando and smaller valleys. In some cases these applications have been actuated by proposed surface storage developments upon the streams applied for as sources.

The difficulties arising in connection with these applications lie in establishing the fact of beneficial use of the water appropriated. In a surface diversion, even including storage, the water impounded or diverted from the stream may be measured and seen. Its course to the place of use can be followed and the water used measured and identified as that diverted or stored. Establishing the fact of beneficial use is a simple matter of observation and measurement.

With an appropriation for underground storage, it is difficult in some cases to determine even the amount stored, unless there is an actual taking of the water out of the stream through ditches. Some spreading comprises merely the placing of obstructions and check dams in the stream channel to retard the flow, and it is difficult to measure the increased percolation caused by artificial methods over that naturally occurring.

Once the water is placed underground, it becomes impossible to trace its movements without intensive investigation. The question arises as to whether the water is used by those in whose interest the application was made, by other users in the same or a distant locality, or whether it passes on beyond the wells and pumps and is evaporated or is lost in the ocean.

The controversies which arise as a result of this uncertainty occur where it is desired to make an appropriation for diversion or storage upstream from the proposed spreading diversion. Spreading *per se* can not be considered an appropriation any more than surface storage, unless the water so spread or stored is beneficially used. Unless this use can be shown, the applicant for spreading can not claim a basis of right upon which to receive a license, or to object to upstream diversion or storage. The solution of the problem would be a statute defining what constitutes beneficial use by spreading.

#### **Overdraft from Basins.**

Another question is that of the over-appropriation, or overdraft, of subterranean basins. The principles laid down in various cases by the Supreme Court of correlative rights as between overlying landowners, and of the superior right of the overlying owner as against the exporter to distant lands, are just and equitable as long as there is no overdraft upon the basin. When, however, the development of ground water has reached and exceeded the safe yield of the basin, and the water levels are persistently falling from year to year, regardless of climatic conditions, additional pumping even for use upon lands overlying the basin should be restricted unless the replenishment can be increased by artificial methods, for it means a gradually increasing pumping lift for all pumps, which may eventually prove prohibitive, and the ultimate reduction of the water available to each irrigator to a quantity less than the amount sufficient to sustain plant growth.

The condition of overdraft exists or is being approached in some sections of the state at the present time, and if the rapid rate of develop-



ment occurring during the last few years is maintained in the future, without artificial replenishment, serious results will ensue.

#### **Underground Water Legislation.**

Generally speaking, the need of legislation relative to ground water is to put into practical effect the rules already laid down by the courts. The Division of Water Rights has administrative jurisdiction over surface water, and partially so over sub-surface water. However, the surface and ground water supplies are so intimately related physically that one can not be satisfactorily administered without consideration of the other. The water does not change with its disappearance underground and subsequent recovery, and the two classes of water rights, surface and underground, when on a single source should not be differentiated either physically or legally, as they apply to the same water. The recent spreading applications connect surface flow and underflow directly, as the water is taken from the one and delivered to the other, to be later recovered and beneficially used.

Mr. Francis Cuttle of Riverside, president of the Conservation Association whose spreading operations on the Santa Ana River have been noted, says in a letter on this subject:

“The only suggestion I have is that the law should be amended so as to give the State Water Commission jurisdiction over underground waters. I have in mind the tremendous expense and long drawn out litigation that has been gone through between the city of San Bernardino, the city of Riverside, and the Riverside Water Company, covering nearly a year of actual trial at court, involving the expenditure of over \$100,000 to the parties to this litigation, and it is not likely that much will be accomplished when all of this expense and trouble has been incurred.”

#### **Recommendations.**

The Division of Water Rights recommends that legislation be adopted covering the following points in connection with underground water:

Defining beneficial use in connection with spreading and underground storage, and amending the present technical requirements of applications to allow this type of filing to be readily handled.

Authorizing the ascertainment of physical facts relative to the water supply of underground basins where overdraft exists or threatens, and the withholding of further permits for diversions from such basins when in the judgment of the Division the beneficial draft exceeds the water crop.

Requiring that application be made to the Division for the appropriation of underground water whenever the same is to be used on other than overlying lands.

# CHAPTER XI.

## FINANCIAL STATEMENT.

The following table shows the income and expenditures of the Division of Water Rights since July 29, 1921, the date on which the act organizing the State Department of Public Works became effective.

TABLE 7.  
FINANCIAL STATEMENT.  
STATE DEPARTMENT OF PUBLIC WORKS.  
DIVISION OF WATER RIGHTS.

Statement of Income and Expenditures for the period July 29, 1921, to June 30, 1922.

INCOME.			
Appropriations—			
Salaries of Commissioners—Chapter 13—1921.....	\$389	75	
Support—Chapter 905—1921.....	71,280	79	
Survey Water Resources—Chapter 411—1921.....	20,035	03	
Treasury Revolving Fund—Chapter 854—1921.....	416	07	
			\$92,121 64
Contributive funds—			
San Joaquin Hydrographic Investigation Fund.....	\$2,407	01	
City of San Luis Obispo Fund.....	500	00	
San Jacinto Fund.....	1,502	37	4,409 38
Total income.....			\$96,531 02
EXPENDITURES.			
Appropriations—			
Administration .....	\$23,511	45	
Applications .....	48,801	59	
Adjudications .....	7,166	13	
Stream Gaging—Cooperative U. S. Geological Survey.....	9,729	63	
San Jacinto Fund—Chapter 411—1921.....	2,912	84	
			\$92,121 64
Contributive funds—			
San Jacinto Fund.....	\$1,502	37	
City of San Luis Obispo Fund.....	500	00	
San Joaquin Hydrography Investigation Fund.....	2,407	01	4,409 38
Total expenditures.....			\$96,521 02
Fees collected and credited to General State Fund.....			\$16,958 41

The income statement is segregated by funds, and those under the heading "Contributive Funds" were not supplied by state appropriation, but by outside interests. The expenditures are similarly divided into "Appropriations" and "Contributive Funds," and the first item is segregated by functional activities.

To complete the record since the submission of the last biennial report of the State Water Commission, there has been prepared also a financial statement covering the period July 1, 1920, to July 29, 1921. This statement will be found in Appendix VI, on page 114.

### Fees.

Fees in the amount of \$16,958.41 were collected in the period July 29, 1921, to June 30, 1922, and have been transmitted to the State Controller and deposited in the state treasury to the credit of the general fund of the state, in accordance with the requirements of the act creating the office. The fees include those received for filing applications, in connection with the issuance of permits, and miscellaneous charges, such as for copying and certifying records, the main portion, however, coming from the permit fees, which are collected on a sliding

scale basis as set forth in the act. The amounts of such fees received during the last five years by the Division and its predecessor, the State Water Commission, have been as follows:

1917-1918 .....	\$4,157 73
1918-1919 .....	3,999 55
1919-1920 .....	6,769 76
1920-1921 .....	16,660 70
July 29, 1921 to June 30, 1922 .....	16,958 41

A very large increase of fees received is noted during the last two years. This has been due to increased activity of the office in issuing a greater number of permits, and also permits for larger projects. The Division of Water Rights has, since July 29, 1921, collected and remitted to the Controller approximately 18 per cent of the amount of money expended during the same time from state appropriations.



## APPENDIX I.

### **SALINITY INVESTIGATIONS IN THE SACRAMENTO AND SAN JOAQUIN DELTA.**

The salinity of the waters of lower Sacramento and San Joaquin rivers during the season of low flow is a serious problem confronting the owners of three hundred thousand acres of rich agricultural land. Several cities and towns are also concerned.

Sacramento and San Joaquin rivers discharge annually an average of approximately 33,000,000 acre-feet and this enormous volume of fresh water formerly swept the salt water out of the delta of these two rivers during the periods of high flow and acted as a barrier in keeping it out. But of late years the irrigation draft has become so great in the summer and fall that the river water in the lower delta becomes at times highly impregnated with salt and unfit for agricultural or domestic use.

The State Water Commission (predecessor of the Division of Water Rights) recognized the seriousness of this problem of increasing salinity in 1916. The First Biennial Report (p. 88) noted the probability that increased diversion from the summer flow of the Sacramento and San Joaquin rivers might cause a correspondingly increased encroachment of salinity into the delta. The Commission took some water samples from the rivers in this area and from Suisun Bay during October, 1916, and again in September, 1919, but no results of importance were obtained.

The light rain and snow fall of the winter of 1919-1920, and the large rice acreage planted in the Sacramento Valley indicated that the salinity condition would in that season become worse than ever before known. At the request of the River Lands Association, and with funds furnished by this organization, the Water Commission undertook a far more comprehensive plan of investigation. A description of the work carried on during this season is contained in the "Third Biennial Report of the State Water Commission" and need not be repeated here. The graphical analyses of water samples taken during the season is reproduced herein, however, in essentially the same form for the purpose of comparing salinity conditions of the year 1920 with those of the succeeding two years.

#### **Investigation Work in 1921 and 1922.**

The work begun in 1920 has been carried on in much the same manner during the periods of low river flow in the summer and fall of 1921 and 1922.

Because of the decreased area affected during the past two seasons it has been unnecessary to maintain so many observation stations as in 1920. The number and location of stations at which samples were taken, as well as the period under observation, is shown for each of the various years in the accompanying tabulation and map. (See Plate 10.)

The observers were instructed to take the samples on alternate days during daylight hours about two hours after the tidal peak, and in moving water unaffected by local influences, then to mail the samples promptly to the office of the Division.

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SALINITY OBSERVATION STATIONS MAINTAINED BY DIVISION OF WATER RIGHTS.

Station	Periods under observation			
	1919	1920	1921	1922
Oakland and Antioch Ferry.		June 2-Dec. 2	July 1-Dec. 30	Sept. 6-
Oakland and Antioch Bridge		June 16-Nov. 19	July 1-Dec. 31	Sept. 8-
Collinsville	Sept. 13-Sept. 19	June 2-Nov. 25	July 1-Dec. 7	Aug. 26-
Antioch	Sept. 14-Sept. 19	June 3-Nov. 22	July 5-Nov. 28	Aug. 26-
Sherman Island Ferry		June 2-Sept. 30	Aug. 6-Oct. 31	
Emmaton	Sept. 14-Sept. 19	June 4-Oct. 6	Aug. 6-Sept. 13	Sept. 20-
Jersey	Sept. 13-Sept. 18	June 2-Dec. 14	Aug. 6-Oct. 31	Sept. 16-
Three Mile Ferry		June 2-Oct. 31	Aug. 7-Oct. 27	
Rio Vista	Sept. 13-Sept. 19	July 23-Oct. 9		Sept. 22-
Ryer Island Ferry		Aug. 16-Sept. 28		
Jones Landing		Aug. 27-Sept. 28		
Island Home		Aug. 14-Sept. 29		
Walker Landing		Sept. 15-Oct. 6		
Isleton		Aug. 14-Sept. 28		
Walnut Grove		Aug. 14-Nov. 1		
Tyler Island Ferry		Aug. 14-Oct. 30		
Central Landing	Sept. 13-Sept. 15	July 22-Nov. 11		Sept. 2-
Venice		July 23-Nov. 13		
McDonald Pump		July 23-Nov. 19		
Webb Pump		July 23-Dec. 13		
Quimby Pump		July 23-Nov. 24		
Orwood Pump		July 22-Nov. 24		
Zuckerman Pump		July 25-Dec. 3		
Junction of North Fork and South Fork of Mokelumne River		Aug. 26-Nov. 19		
North Fork Pump		Sept. 18-Oct. 9		
Terminus		Sept. 18-Nov. 19		
Camp 24		Sept. 18-Oct. 19		
New Hope Bridge		Aug. 26-Nov. 19		
Wakefield		Aug. 7-		
Sacramento		Sept. 21-		
Sing Kee Landing		Oct. 9-Oct. 15		
Blylock Landing on Bradford Island	Sept. 13-Sept. 19			
Camp 35		Aug. 26-		

Observation season not yet closed on October 15th.

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The object in taking the samples approximately two hours after the tidal peaks was to secure data for both maximum and minimum salinity conditions. As pointed out in the Third Biennial Report (p. 92) there is a lag of some two hours after high tide before maximum salinity is reached and a corresponding lag after low tide before minimum salinity is reached. This lag is doubtless to be explained by the fact that the reversal in tidal current does not come at the peak of the tide, but from one and one-half to two and one-half hours later. This will be understood if one stops to consider that the tidal peaks are some six hours later at Sacramento than at Collinsville and therefore after high tide is reached at Collinsville, and the water level begins to fall at that point, there must continue for a time a tidal current toward Sacramento until an equilibrium is established with up-river points. The reverse is, of course, true at low tide.

The samples received have been tested for chlorine in the office of the Division by titration with silver nitrate, the parts of chlorine being expressed in parts per 100,000. To obtain parts of salt the results are multiplied by 1.65.

#### Graphical Analyses of Results Obtained.

Besides the accompanying map (Plate No. 10) there are contained herein three plates illustrating graphically the salinity conditions as they have been observed in the delta by the office of the Division during the past four years. Plate No. 11 has been designed to illustrate the relation between salinity in the delta and the flow in the Sacramento and San Joaquin rivers. Plates No. 12a and No. 12b have been designed to better illustrate the comparative advance and retreat of salinity in the delta at similar dates in different years. It is quite clear from the graphs that Sacramento River has an important influence upon salinity conditions at points on San Joaquin River below Georgiana Slough, and that San Joaquin River has little or no effect upon salinity at points on Sacramento River.

There is unanimous agreement among students of the problem that if sufficient discharge be maintained in the Sacramento and San Joaquin Rivers the salt water can be kept back and the menace of increasing salinity removed from the delta. There is as yet, however, no agreement as to what would be sufficient discharge to accomplish this purpose. There are as yet insufficient data upon which to safely base a close estimate of minimum flow.

One of the principal obstacles to basing such an estimate upon the results of investigations already made is the difficulty in establishing closely the river discharge at Sacramento because of the tidal influence there. At low stages of the river the tide alone may cause a variation of as much as three feet in the water level, thereby making it exceedingly difficult to establish a satisfactory gaging station.

To establish the approximate flow of Sacramento River at Sacramento in the years 1919, 1920, and 1921, data obtained at or near that point by the State Engineer's office have been used. For the year 1922, no records of flow at Sacramento were obtainable and the flow has therefore been established approximately by taking the sum of the combined discharges of Sacramento River at Knights Landing, Feather



River at Nicolaus, and American River at Fair Oaks, where gaging stations were maintained by the United States Geological Survey.

While it is appreciated that there is a considerable diversion by pumping for irrigation between these stations and the city of Sacramento, there is also no doubt a very considerable return flow. The records obtained in 1921 by the State Engineer's office for this set of three stations overlaps for a period of 106 days the record maintained by the same office at Sacramento, and there is noted a 7 per cent increase between the upper and lower sets of stations. There are no available data on return flow in this section of the river but the data given in Appendix III is interesting in this connection.

There are considerable variations in daily river discharge and there are also considerable variations in salinity conditions as revealed by the samples taken, so that the graphs of Plate No. 11 must be considered as representing average conditions of maximum daily salinity rather than exact conditions for particular days.

The data obtained in 1919 were meager and the results obtained unsatisfactory.

#### Conclusions.

The difficulty in exactly determining the flow of water into the delta, the rapidity with which the rate of flow changes, and the very apparent lag in time between the date on which the flow arrives at a critical stage and the date when the effect of that critical stage becomes apparent in samples taken, makes impossible at this time any exact determination of the amount of flow required to keep the water to any specific degree of freshness in the delta.

It would appear that there will probably be no apparent increase in salinity as a result of the continuation of low flow for a brief period, but that the same flow continued for a longer period may bring about a marked increase in salinity conditions.

It appears clear that with a combined discharge of less than 15,000 second-feet in the two rivers there very soon begins an increase in the saline content of the water at Oakland-Antioch ferry, and that in years of extreme low summer flow the salinity at this point may become as high as 900 parts chlorine in 100,000.

It appears probable that soon after the combined flow of Sacramento and San Joaquin rivers falls to 7500 second-feet it may be expected there will begin an increase in the salinity at Antioch, and that this increase may in a season of minimum flow reach a maximum of at least 735 parts chlorine in 100,000. In years more nearly approaching normal a minimum combined discharge from the two rivers approximating 4000 second-feet will probably prevent the salinity increasing beyond 250 parts chlorine per 100,000 at Antioch.

At Jersey on Jersey Island it appears the salinity increase becomes marked soon after the combined river discharge falls to 4000 second-feet and may reach a condition of 325 parts chlorine in 100,000 in years of extreme low flow. In years more nearly approaching normal when the combined river discharge falls little below 4000 second-feet it is probable the salinity at this point will not exceed 35 parts chlorine.

At Central Landing on Bouldin Island it does not appear that there is any marked increase in salinity until shortly after the combined

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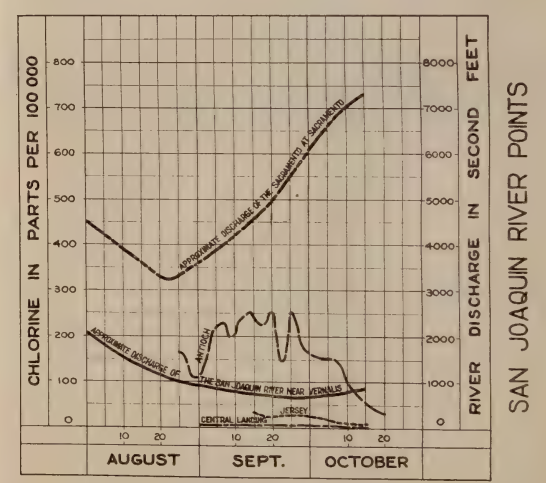
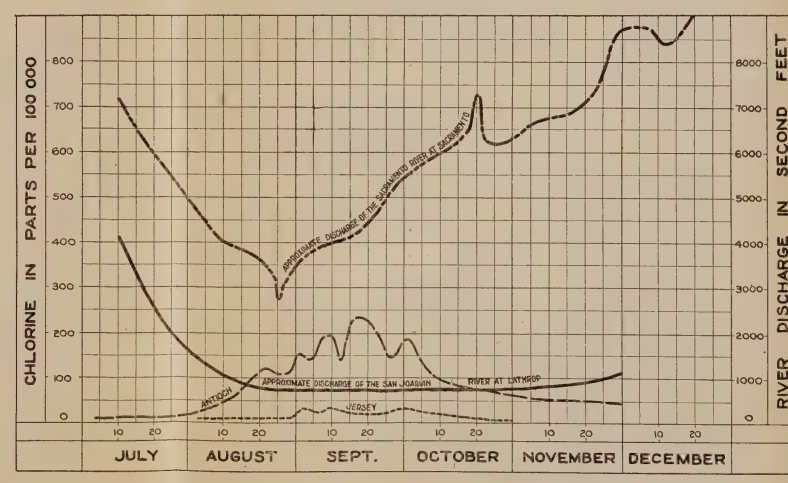
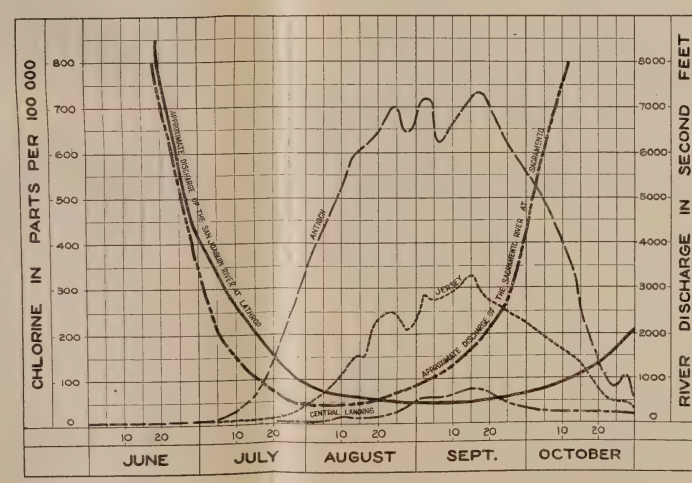
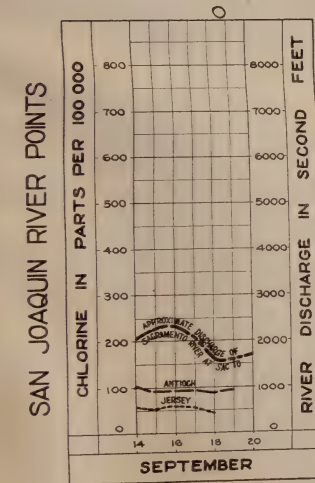
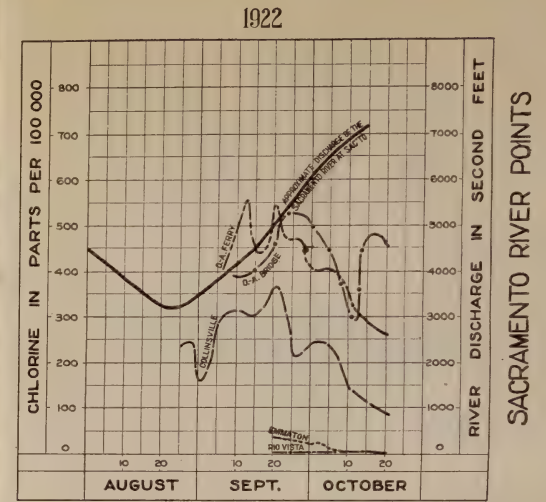
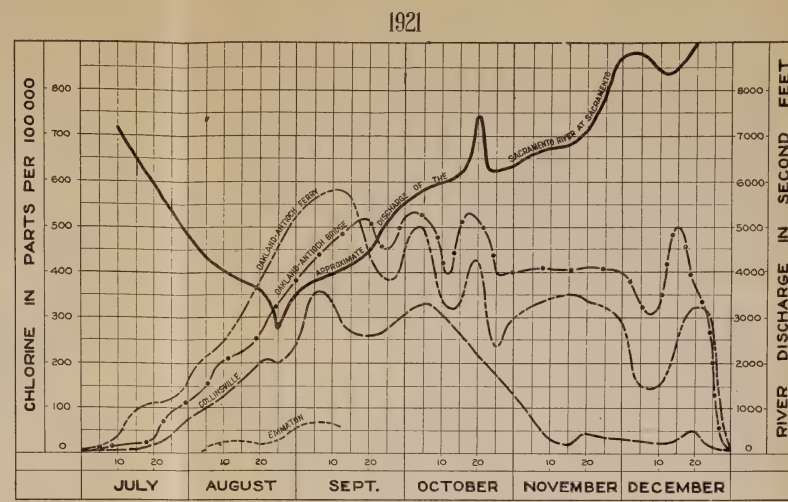
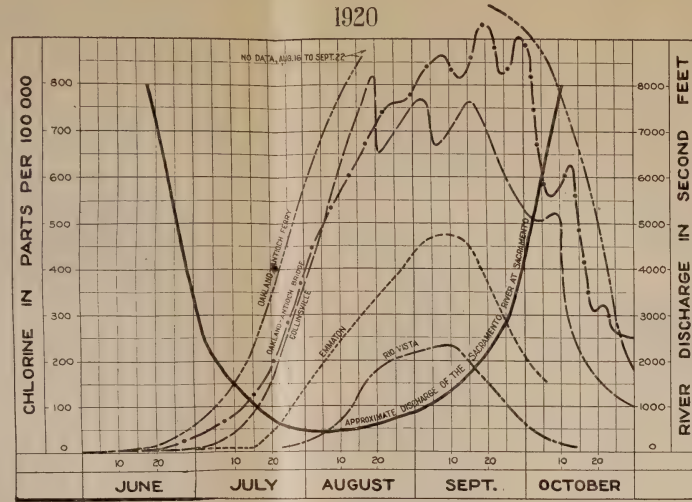
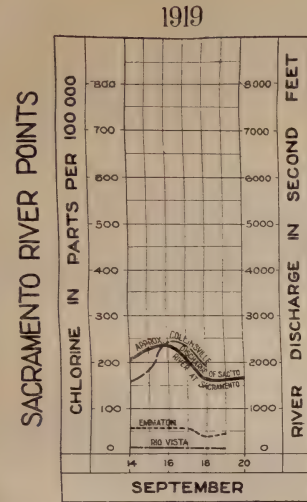
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# RELATION OF SALINITY IN THE SACRAMENTO-SAN JOAQUIN DELTA TO RIVER DISCHARGE

NOTE: SALINITY CURVES INDICATE MAXIMUM SALINITY DURING DAYLIGHT HOURS





discharge of the two rivers falls below 1500 to 2000 second-feet. It will reach a maximum of at least 75 parts chlorine in 100,000 in years of extreme low flow, but during years in which the minimum combined flow of the two rivers remains above 4000 second-feet will probably remain below 10 parts chlorine.

Sacramento River at Emmaton begins a very rapid increase in salinity soon after the flow at Sacramento reaches the 2000 second-foot stage. It may reach a maximum of 475 parts chlorine in years of extreme low flow. When the flow of Sacramento River at Sacramento is maintained above 3000 second-feet the salinity at Emmaton appears to remain below 50 parts chlorine.

Rio Vista appears to suffer no marked increase in salinity until after the Sacramento River at Sacramento falls to the 1000 second-foot stage and will reach a maximum of at least 235 parts chlorine in years of extreme low flow. During years when the flow is maintained above the 3000 foot stage there will probably not be in excess of 4 parts chlorine at Rio Vista.

A decrease in the winter and spring flood run-off by storage, an increase or decrease in the amount of return flow caused by up-river diversions for irrigation, or the deepening of the river channels by dredging for the benefit of navigation may bring about important changes in the salinity problem confronting the delta region.

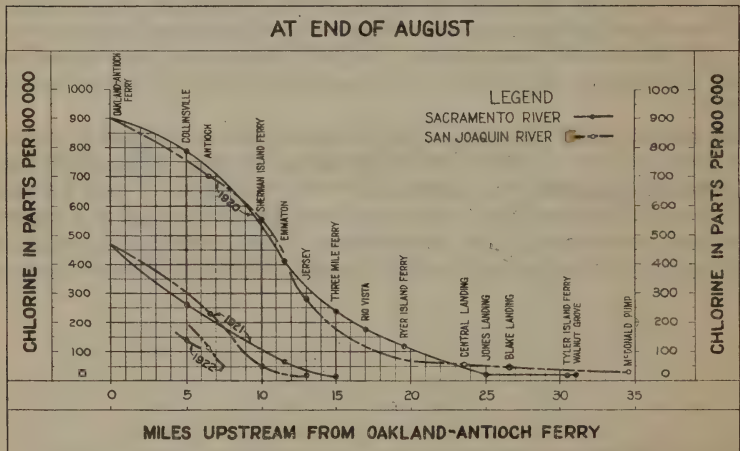
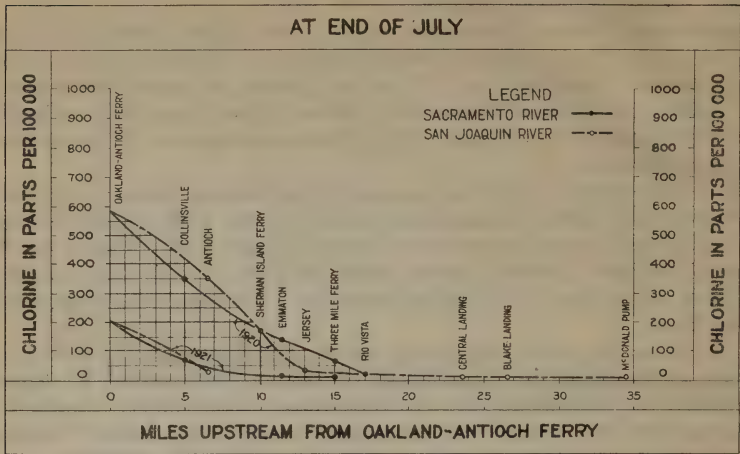
Some 300,000 acres of the richest agricultural land in the state depend upon the river flow through the delta for an irrigation supply diverted at points where the water becomes impregnated during the season of low flow with the salt of ocean water. In 1920 this entire area drew from a supply containing in excess of 30 parts chlorine (50 parts salt) per 100,000.

This menace may be met, as has been heretofore proposed, either by the construction at a point below the delta of some collapsible dam to hold back the salt water at times of low river flow, or it may be met by regulation of the river flow to some safe minimum through the operation of storage reservoirs in the mountains. The correct solution is only to be found by an extended study of a multiplicity of diverse factors.

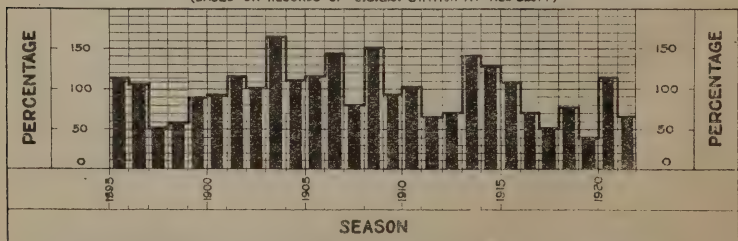


# ADVANCE AND RETREAT OF SALINITY IN THE SACRAMENTO - SAN JOAQUIN DELTA

THESE CURVES INDICATE COMPARATIVELY THE SALINITY IN THE DELTA ON APPROXIMATELY THE SAME DATE IN DIFFERENT YEARS. SAMPLES TAKEN AT HIGH TIDE THUS INDICATING MAXIMUM SALINITY.

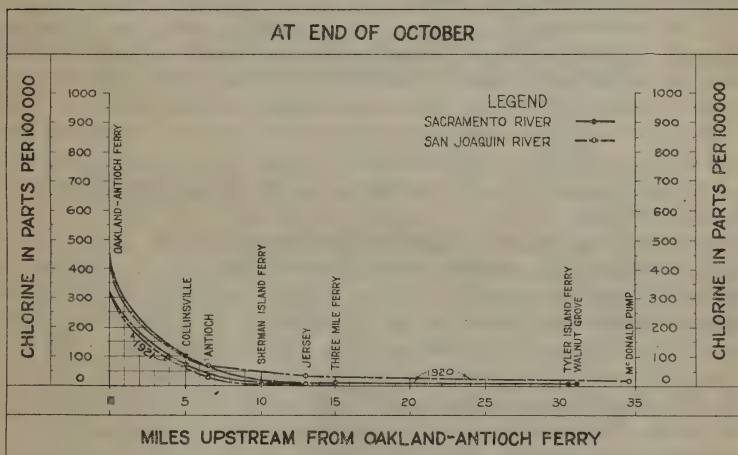
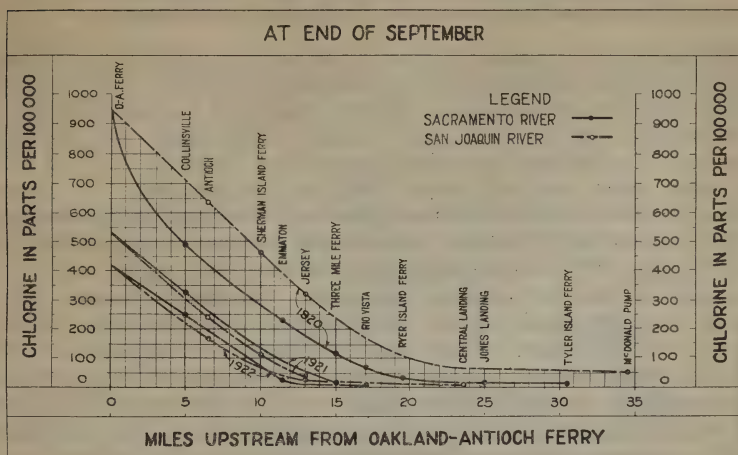


## RUNOFF OF THE SACRAMENTO RIVER IN PERCENTAGE OF NORMAL (BASED ON RECORDS OF U.S.G.S. STATION AT RED BLUFF)

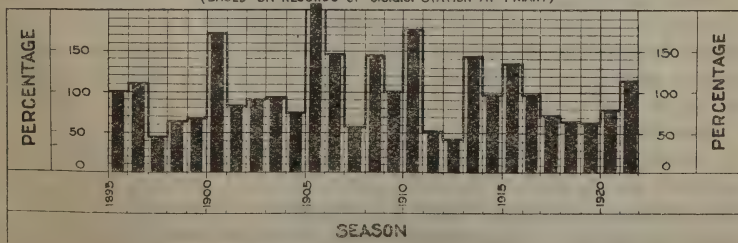


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## APPENDIX II.

### INVESTIGATION IN CONNECTION WITH PERMITS IN SACRAMENTO VALLEY FLOOR.

#### Irrigation Development and Relation to Division of Water Rights.

Within the last ten years the development of irrigation in the Sacramento Valley has advanced with remarkable rapidity. The causes of this advance are numerous. In former years the raising of grain with no irrigation was found to give ample return upon the investment. Later, with the increase in land values and the "wearing out" of the soil from year after year of grain farming, the necessity for products yielding greater returns became apparent. Such a change demanded the development of irrigation. As a whole the Sacramento Valley, from considerations of its topography, soil, climate and water supply, was admirably adapted for such development. The land was such that the cost of preparation, leveling, construction of canals, etc., could be reduced to a minimum. There was practically no clearing to be done. Although conditions were such that a gravity supply of water could not be economically secured, it was found that the development by pumping from the Sacramento River with comparatively low lifts was entirely feasible and compared very favorably with the cost of gravity supply elsewhere.

As one of the greatest causes in the growth of irrigation in the valley, the development of the rice industry must be prominently mentioned. The growing of rice in the Sacramento Valley began to assume an important place in about the year 1916. In the upper portions of the valley there were some lands which had been thought unfit for any crop, but which proved to be very well adapted for the growth of rice. With a very decided increase in the price received for rice from 1915 to 1919, the acreage of this crop was increased to a remarkable extent.

As practically all of the irrigation development in the valley has been brought about within recent years, the acquirement of the necessary water rights by the majority of the various projects diverting water has been through application to the Division of Water Rights under the terms of the Water Commission Act. Such applications for appropriation of water from the Sacramento River commenced to be filed about 1915 and the number received each year increased very rapidly up to 1920. The extent of the applications upon which permits have been issued, as to number and area covered, is shown on the accompanying map, Plate 13, page 100. On this map the total valley agricultural area north of Sacramento has been given as the outer boundary, the area of the projects under permit is shaded and the application numbers, indicative of the relative priorities, are shown opposite the respective points of diversion from the river. In the accompanying Table 16, all permits granted to October 15, 1922, within the valley area have been listed.

The valley agricultural area north of Sacramento, as shown on the map, totals about 2,070,000 acres, and the total acreage under permit, 369,947 acres, amounts to about 18 per cent of that area.

In addition to the applications upon which permits have been issued, as given in Table 16, there have been received forty-four applications



within the valley upon which action has not yet been taken. Included in this group there are two applications covering the Iron Canyon Storage Project calling for 3170 second-feet for 284,363 acres. Omitting these two applications, those remaining, upon which action is pending, have applied for a total of 2753.9 second-feet for a total area of 225,729 acres.

In Table 8 a segregation as to source has been made of both applications upon which permits have been issued, and those upon which action is pending. In the tabulation of the latter, those of the Iron Canyon Project have been omitted.

TABLE 8.

Segregation of Pending and Permitted Applications in the Sacramento Valley as to Source.

Source	Applications upon which permits have been issued			*Applications upon which action is pending		
	No.	Amount, second-feet	Acreage	No.	Amount, second-feet	Acreage
Sacramento River.....	75	5,148.36	317,556.91	21	2,146.82	191,633
Trough of Colusa Basin.....	19	179.33	20,609.70	2	181.00	7,490
Feather River.....	3	750.00	41,116.20	7	218.35	14,205
American River.....				1	10.00	267
Small tributaries, sloughs and drains.....	15	180.13	12,276.00	11	197.73	12,134
Totals.....	97	6,137.04	369,947.01	42	2,753.90	225,729

\*This tabulation omits two applications covering the Iron Canyon Project and amounting to 3,170 second-feet for 284,363 acres.

<sup>1</sup>Five permits include both Sacramento River and Trough of Colusa Basin as source.

<sup>2</sup>120.78 second-feet issued for either Sacramento River or Trough of Colusa Basin as source.

<sup>3</sup>21,611.8 acres covered by permits from both Sacramento River and other sources, Trough of Colusa Basin and Sacamore Slough.

## Field Work.

In conformity with the terms of the Water Commission Act, requiring that a field inspection be made of each project under permit at the expiration of the date set for completion of same, there were, at the beginning of the 1921 season, about seventy permits in the Sacramento Valley requiring inspection. Prior to 1921 the total number of inspections that had been made was thirteen. These were made during the 1919 season. Although there had been no inspections other than these prior to 1921 there was carried on in the Valley during the 1920 season a large amount of work by the engineers of the Emergency Water Conference, the results of which have been made available to this Division and have proved of great value in connection with a study of the use of water for rice as later outlined. The work of the Emergency Water Conference and reasons for its formation have been described in the Third Biennial Report of the State Water Commission. With the beginning of 1920 a great extension in acreage to be irrigated was planned. This was a result of very favorable prices received for farm produce in 1919. Coupled with the extension in acreage were the indications that the 1920 season would be one of the driest years in the history of the Sacramento River. The seriousness of the situation increased as the season advanced, resulting in the formation of the Emergency Water Conservation Conference, consisting of representatives of the State Water Commission, the Railroad Commission, the State Engineer, and various other state and federal offices, to carry out

under agreement between the water users on the Sacramento River, the regulation of diversions and use of water.

A water master was selected and established headquarters at Colusa with a force of assistants to carry out the details of the work. A great deal of data as to acreages planted and irrigated and amount of diversions was collected. When it became apparent that acreage reductions would be required, these were agreed to upon the water master's recommendation and a maximum crop for the available water supply was matured without serious conflict. Of the work of Emergency Water Conference Engineers, that particularly useful to this office in a study of the use of water for rice consisted in the making of from one to four measurements of discharge during the season at each of twenty-five large pumping plants belonging to members of the Conference. At the time of making each measurement careful observations as to power input and head were also taken, so that each measurement could be used in determining a relation between power input, head and discharge. In addition to these measurements, a full inspection was made of each project from which the actual acreage and crops irrigated were indicated on a map of the project.

In issuing permits for the appropriation of water for rice culture in the earlier years, the rice industry being new and very little data being available as to the amount of water actually needed for rice, the Water Commission adopted, tentatively, the rate of one second-foot to forty acres irrigated. In each permit so granted, however, there was placed a clause stating that the amount of water granted was subject to reduction in the license if investigation so warranted.

In view of the above, it has developed that in the Sacramento Valley work, in addition to the usual permit inspections, considerable time and attention was required to be devoted to investigations looking toward a determination of the proper allowance of water for rice. As above outlined, the work of the Emergency Water Conference contributed a great deal to this investigation in 1920. In 1921 an inspection of seventy Sacramento Valley projects under permit was made. At the time of making these inspections each rice project was given especial attention in the matter of acreages irrigated, amount of diversions, length of season, soil, canal losses, waste, etc. By the 1920 discharge measurements a means was provided whereby with data as to the power consumed at the various pumping plants, a computation of monthly and seasonal diversion at those plants could be made. This was obtained for from two to five years for all projects under permit and for the 1920 season was obtained for every pump on the river from Red Bluff to Sacramento. During the 1922 season an inspection of twenty-two projects under permit was made.

#### **Type of Development.**

In general, all of the Sacramento Valley irrigation development is of the same type. As shown by the inspections, the majority of projects are for large acreages, the pumping installations have been for large capacities, and the canal systems are extensive. The pumps installed are nearly all of the horizontal centrifugal type, the majority varying in size from ten inches to about thirty-six. Some few projects have installed exceptionally large pumps or batteries of pumps

with sizes of centrifugal pumps running up to fifty-two inches. The pumps operate under heads varying on an average from about ten to about thirty feet. In the case of two large projects where the head is somewhat less than the average, the screw pump has been developed very successfully. The development of this pump has permitted the installation of single units of enormous capacity. The maximum installation of this nature is that of a one hundred and eight inch screw pump with rated capacity of three hundred and seventy-five cubic feet per second. With the rapid development as experienced in the valley, and especially with the sudden increase in use for rice of large areas hitherto barren, the construction works and use of water have been carried on in large units. Canals have been thrown up hurriedly without lining and by reason of the level topography a maximum area of land has been covered with a minimum of outlay.

Selecting thirty-three projects of those inspected in 1921 as best representing the Sacramento Valley type of irrigation development, the data from them as given in Tables 9 and 10 indicates the status of the use of water. Upon these thirty-three projects a total of forty-five permits has been issued.

TABLE 9.

Proportion of Total Acreage Under Permit, Which Was Irrigated During Year of Maximum Irrigation, on Thirty-three Typical Projects.

Maximum per cent of total acreage of project irrigated in any one year	Number of projects	Total acreage of projects	Total maximum acreage irrigated	Average number of years under permit
90 to 100.....	10	33,258	32,981	3.70
75 to 90.....	5	21,259	18,760	5.00
50 to 75.....	5	45,643	25,960	4.40
25 to 50.....	10	133,126	57,403	3.80
Below 25.....	3	16,976	877	4.00
Total.....	33	250,262	135,981	

TABLE 10.

Use of Water on Thirty-three Typical Projects Under Permit During the Period 1916 to 1921.

Year	Number of permits granted up to beginning of season	Acreage under permits up to beginning of season	Acreage irrigated	Acreage irrigated in per cent of that under permit
1916.....	4	25,815	14,965	58
1917.....	16	91,008	27,105	30
1918.....	29	182,684	61,915	34
1919.....	41	228,940	96,854	42
1920.....	43	233,664	115,202	50
1921.....	45	250,262	61,920	25

Of the thirty-three projects used as a basis for Tables 9 and 10 eighteen are those upon which rice is the chief crop grown. These eighteen projects represent the greater portion of the rice area under permit and have a total acreage of 168,171 acres.

#### Rice Culture and Water Requirements.

The requirements and use of water in rice culture differ greatly from those for general crops, such as alfalfa, corn, orchard, etc. The



rice is sown generally in the last of April or early part of May and immediately thereafter the fields must receive their initial flooding for germination. For best results the capacity of ditches must be such that heads of water of sufficient size are available to quickly flood the entire area from four to six inches in depth. Subsequent to the initial flooding, and during a period of about forty to fifty days, the fields must be given a sufficient number of flushings, varying from three to six, to keep the soil fairly moist during germination. About thirty days after emergence of the plants above ground the fields are flooded and the water is held continuously thereafter until the crop is matured. The period of submergence varies from about ninety to one hundred and twenty days, depending upon the variety of rice. The total length of season of use of water is, then, from about one hundred and thirty to one hundred and seventy days. Within the last few years it has been found in some localities, in combating water-grass, which is one of the greatest obstacles encountered in the growing of rice, that by holding the fields in submergence for the entire season, including the early period, the rice will grow up through the water, but the water-grass will not. It would appear that this change in the use of the water for the purpose of fighting water-grass, might somewhat change the total seasonal requirements. Just what the change would amount to is yet to be established. With the method of intermittent flushings there are short periods when water is used in large quantities and other periods when no water is used. On the other hand, in holding the water from the beginning, there is a continuous diversion but of smaller amount, after the initial flooding, and evaporation in this early period is less than that later in the season. With ordinary practice the period of the initial flooding and the period of beginning of submergence are the times of greatest need for water. However, under a large project or a number of projects under one canal system, the periods just mentioned are unlikely to occur simultaneously for the various fields and the demand for water at the point of diversion should not, therefore, be made greater than later in the submergence period. In fact, with the heavy evaporation occurring in the latter part of June, in July and in August, when all fields are submerged, it is probable that the peak demand at the point of diversion of the larger projects may occur in these months. This would appear to be substantiated in the accompanying Table 11. Here, by using the data obtained of monthly power consumption at the various pumping plants the monthly demand in per cent of the seasonal demand was easily shown. The figures in the table represent the average of two or three seasons for thirteen rice projects.

TABLE 11.

Monthly Demand for Water at Point of Diversion in Per Cent of Seasonal Demand on Sacramento Valley Rice Projects.

Month	Monthly demand in per cent of seasonal
April.....	2.9
May.....	11.3
June.....	20.4
July.....	22.5
August.....	21.9
September.....	17.0
October.....	4.0
Total.....	100.0

An average was taken of the maximum monthly demands on the same thirteen projects, irrespective of the month in which the maximum occurred, and found to give a figure of 26 per cent.

The growth and history of the rice industry in California are very concisely told in the figures given in the accompanying Table 12. These are the figures for each year, of the rice acreage, production and price received, as obtained from the office of the California Cooperative Crop Reporting Service.

TABLE 12.  
Growth of Rice Industry in California.

Year	Acreage of rice harvested			Production for state, 100 lb. sacks	Price received per 100 lbs.
	Sacramento Valley	San Joaquin Valley	Total for state		
1910-----	100	-----	100	1,350	\$1.44
1911-----	150	-----	150	2,700	1.67
1912-----	1,400	-----	1,400	31,500	2.02
1913-----	6,100	-----	6,100	131,800	2.22
1914-----	15,000	-----	15,000	360,000	2.22
1915-----	34,000	-----	34,000	1,020,600	2.00
1916-----	58,000	-----	58,000	1,539,900	1.73
1917-----	80,400	2,600	83,000	2,539,800	3.89
1918-----	107,780	4,220	112,000	3,301,200	4.22
1919-----	148,500	6,500	155,000	4,185,000	5.93
1920-----	154,000	8,000	162,000	3,717,900	2.69
1921-----	132,700	2,300	135,000	3,280,500	2.56
1922-----	138,500	3,500	*142,000		

\*Acreage planted.

Average price received during the period 1910 to 1916, inclusive, \$1.90 per 100 lbs.

The price received for rice is, of course, one of the largest factors controlling the acreage planted. This is very clearly illustrated in the table. With the remarkable increase in price received up to and including 1919, the acreage planted increased by great jumps, while subsequent to the slump in price in 1920 the 1921 acreage shows a very decided drop. With high prices such as those of 1918 and 1919, factors such as the cost of irrigation water, the sufficiency of water supply, adaptability of soil, etc., were hardly given proper consideration in the planning of future acreage. As a result, considerable areas of rather pervious land where the use of water was excessive were planted. These lands were excellent for general crops but entirely unsuited to properly grow rice. Over-expansion, due to high prices received, was the 1920 condition just prior to the great slump in price. With a return to a normal price the factor of the cost of water will undoubtedly be effective in confining the rice areas to lands having soils suitable for rice culture, that is, the clays and clay adobes with impervious subsoils which retain the water in the rice checks with a minimum of loss.

As a result of the 1920 and 1921 investigations into the amount of water used by the various rice projects, the computations for fifteen large and representative projects with total acreage (not all planted) under permit of 193,317, or an average of 12,888 acres, show the average seasonal use at the point of diversion varying from 6.12 to 10.31 acre-feet per acre, with an average of about seven acre-feet per acre. For an average length of season of one hundred and sixty days the use of seven acre-feet per acre is equivalent to a continuous diversion throughout the season of one second-foot for every forty-six acres. As

previously outlined, the average maximum monthly diversion appears to be about twenty-five per cent of the seasonal use. On this basis, for the seasonal diversion of seven acre-feet per acre, the maximum monthly diversion would amount to one and eight-tenths acre-feet per acre, or an area of thirty-five acres served per second-foot during that month. On account of the growth of water-grass it has been the rice growers' experience, in general, that a successful crop can not be grown for more than three consecutive years on new land or for more than two consecutive years on land which has been allowed to lie fallow or has been used for general crops subsequent to use for rice. This has led to the necessary practice of allowing certain lands to lie fallow or to be used for general crops each year. On a large project, therefore, the percentage of the total area cropped to rice each year may be as low as fifty per cent, and will probably not exceed eighty per cent. In estimating the requirements of a project at point of diversion, therefore, using the entire acreage as a basis, a figure for seasonal use such as seven acre-feet per acre as given should be decreased. With a maximum acreage of eighty per cent cropped the seasonal use or "duty", applied to the entire project, would become 5.6 acre-feet per acre, or an area served per second-foot of fifty-seven acres. The difference between the maximum amount of water required for the loam soils and minimum amount required by the clays and clay adobes is clearly indicated in the investigations. In a study of the water requirements at the point of diversion for large projects, however, any well defined relation between water requirements and soil types between the two extremes of loams and clay adobes is found to be obscured by such factors as relative size of project, size of canal system, canal losses, etc.

#### Water Supply—Diversions—Return Water.

In the light of the rapid development of irrigation in the Sacramento Valley as outlined, the question of water supply is naturally one to which serious consideration must be given. Probably the best indication of crucial conditions in this regard was given during the 1920 season when, with a maximum acreage planted, there occurred the lowest recorded flow in the history of the Sacramento River. As computed from the data on power consumption, the total diversions on the river from Red Bluff to Sarcamento for the months May to September, inclusive, 1920, amounted to 969,200 acre-feet. This is shown by months in Table 13.

TABLE 13.

Diversions by Sacramento River Pumping Plants Red Bluff to Sacramento for 1920 Season.

Month	Diversions in acre-feet
May.....	126,000
June.....	232,600
July.....	233,600
August.....	204,900
September.....	172,100
Total.....	969,200

Records of the flow of the Sacramento River for the 1920 season at Red Bluff are available from the United States Geological Survey, and at Butte City, Colusa, and Knights Landing from the Division of Engineering and Irrigation, State Department of Public Works. The



station at Knights Landing is located below the point of return to the river of water from the Colusa Drain. This water is practically all "return water" from rice irrigation and represents a considerable percentage of all the water returning to the river from Sacramento Valley irrigation. During the irrigation season, the amount of water other than return water from irrigation, reaching the Sacramento from its tributaries between Red Bluff and Knights Landing, is negligible. Using the data on pumping diversions and the records of flow of the river at the various points, an indication is given in Tables 14 and 15 of the relation which existed between supply and demand in a critical year such as 1920, and shows as well the amount of water returning to the river. In connection with the latter, it should be noted that in the section between Colusa and Knights Landing there is, entering the river through Butte Slough, a considerable amount of return water from lands irrigated from the Feather River and Butte Creek. For the 1920 season there were no available records of the exact amount of this inflow through Butte Slough. To get, therefore, the amount of return water from the Sacramento River draft it was necessary to estimate as closely as possible the Butte Slough return from foreign sources. It is evident that with the available data, the return water results as given cannot be taken as conclusive. They should, however, be indicative of conditions in this respect and are only presented as such. The importance of a knowledge of the amount of return water in the predication of future water supply and the small amount of work done in the past in this connection serves to point out the desirability of further investigations.

**TABLE 14.**  
**Monthly Variation in 1920 for Discharge, Diversions and Return Water on Sacramento River for Section Red Bluff to Knights Landing.**

(1) Month	(2) Discharge at Red Bluff, acre-feet	(3) Pumping draft between Red Bluff and Knights Landing, acre-feet	(4) Red Bluff discharge less pumping draft Col. 2-Col. 3, acre-feet	(5) Discharge at Knights Landing, acre-feet	(6) Return water Col. 5-Col. 4, acre-feet	(7) Return water from foreign sources entering through Butte Slough, acre-feet <sup>1</sup>	(8) Return water from Sacramento River irrigation Col. 6-Col. 7, acre-feet	(9) Return water in per cent of pumping draft
June.....	248,000	220,400	27,600	198,500	170,900	3,000	167,900	30.8
July.....	221,000	216,900	4,100	22,500	18,400	5,000	13,400	6.2
August.....	207,000	192,000	15,000	39,400	24,400	9,000	15,400	8.0
September.....	205,000	165,200	39,800	112,000	72,200	14,000	58,200	35.2
Totals.....	881,000	794,500	86,500	272,400	185,900	31,000	154,900	19.5

<sup>1</sup>Rating curve prior to June 14 indefinite. Total for June estimated.

<sup>2</sup>Based upon use of uncertain record for June flow at Knights Landing (see Note <sup>1</sup>). This figure may also include some inflow from tributaries, flowing as late as June, which would not have been taken into account.

<sup>3</sup>Approximate estimate.

Note.—Records for the section Red Bluff to Colusa show discharge at Red Bluff 361,000 acre-feet, pumping draft in the section, 92,100 acre-feet, inflow less draft, 268,900 acre-feet, and outflow from section, 284,000 acre-feet. This gives in this section for May a return of 15,100 acre-feet, or 16.4% of the draft.

TABLE 15,

Totals of Discharge, Diversions and Return Water for Period June to September, inclusive, 1920,  
on Sacramento River Sections between Red Bluff and Knights Landing.

	Red Bluff to Butte City	Butte City to Colusa	Colusa to Knights Landing
Inflow to section, acre-feet.....	881,000	460,700	326,000
Pumping draft in section, acre-feet.....	449,900	158,400	186,200
Inflow less draft, acre-feet.....	431,100	302,300	139,800
Outflow from section, acre-feet.....	460,700	326,000	272,400
<sup>1</sup> Return water in section, acre-feet.....	29,600	23,700	132,600 —31,000
<sup>1</sup> Return water in per cent of pumping draft.....	6.6	15.0	<sup>1</sup> 101,600 <sup>2</sup> 54.5

<sup>1</sup>Particular note should be taken of the fact that the figures given under these heads represent the return for 4 months, June to September, inclusive, and include, therefore, the high return in the latter part of the period of water drained from the rice fields (see return per centage given for September in preceding tabulation).

<sup>2</sup>Estimate of inflow from Butte Slough of return water from foreign sources.

<sup>3</sup>A large percentage of return water in this section is through definite channels which have collected drainage from all of the River Sections considered.

In connection with a study of return water from rice irrigation, a somewhat significant fact is brought out in comparing the average amount of water diverted by the rice projects as heretofore described with the average net use of water at the fields as described in Bulletin No. 325 of the College of Agriculture, Agricultural Experiment Station, University of California. As stated in this bulletin, the result of rice irrigation measurements and experiments in the Sacramento Valley carried on from 1914 to 1919 by the experiment station in cooperation with the State Water Commission showed that "An annual depth of five feet of irrigation water for rice is sufficient for the principal rice soils of the Sacramento Valley, viz, for the clays and clay adobes of the Willows, Stockton, Sacramento, Capay and Yolo Series". As shown in this bulletin the seasonal use of a five-foot depth of water represents the net use of water at the fields after allowance for controllable losses and waste has been made. With, then, a net use at the fields of 5 acre-feet per acre and diversion at the pumping plants on the large projects of 7 acre-feet per acre, it would appear that there should be available as return water for lower users somewhere between one and two acre-feet per acre, allowing for canal loss not returning to the river but percolating to ground water.

#### Future Development.

With a return to stabilized conditions, the future of the Sacramento Valley irrigation development, and especially that of the rice development, will depend chiefly upon such factors as the market prices, water supply, drainage, the success of the struggle with water-grass and the total area of land properly suited to rice culture. These factors are all inter-related. With a normal price for rice the cost of water must be kept down. To keep the cost of water down it will be necessary to use only those lands with soils such that an excessive use of water is not required. With the increasing demand for water, the shortage of supply will also require the most economical use of water. With normal conditions the excessive cost of drainage works to prevent the well-known injury that results to lands from rise of ground water and



attendant damage from alkali, will, in the case of the pervious soils, eliminate their use for rice. The necessity of thorough drainage on any rice lands, not only to keep these soils good for rice, but to prevent damage to other lands, must be more carefully considered in proportioning the future costs.

The development of the Sacramento Valley has been so rapid and the problems encountered are so peculiar to the valley that a considerable further study of water problems is necessary. It is believed that the work done so far lays the foundation for the more extensive and intensive study and field investigation which should be in progress during the next several years.

<sup>1</sup>Includes area of Application 180.

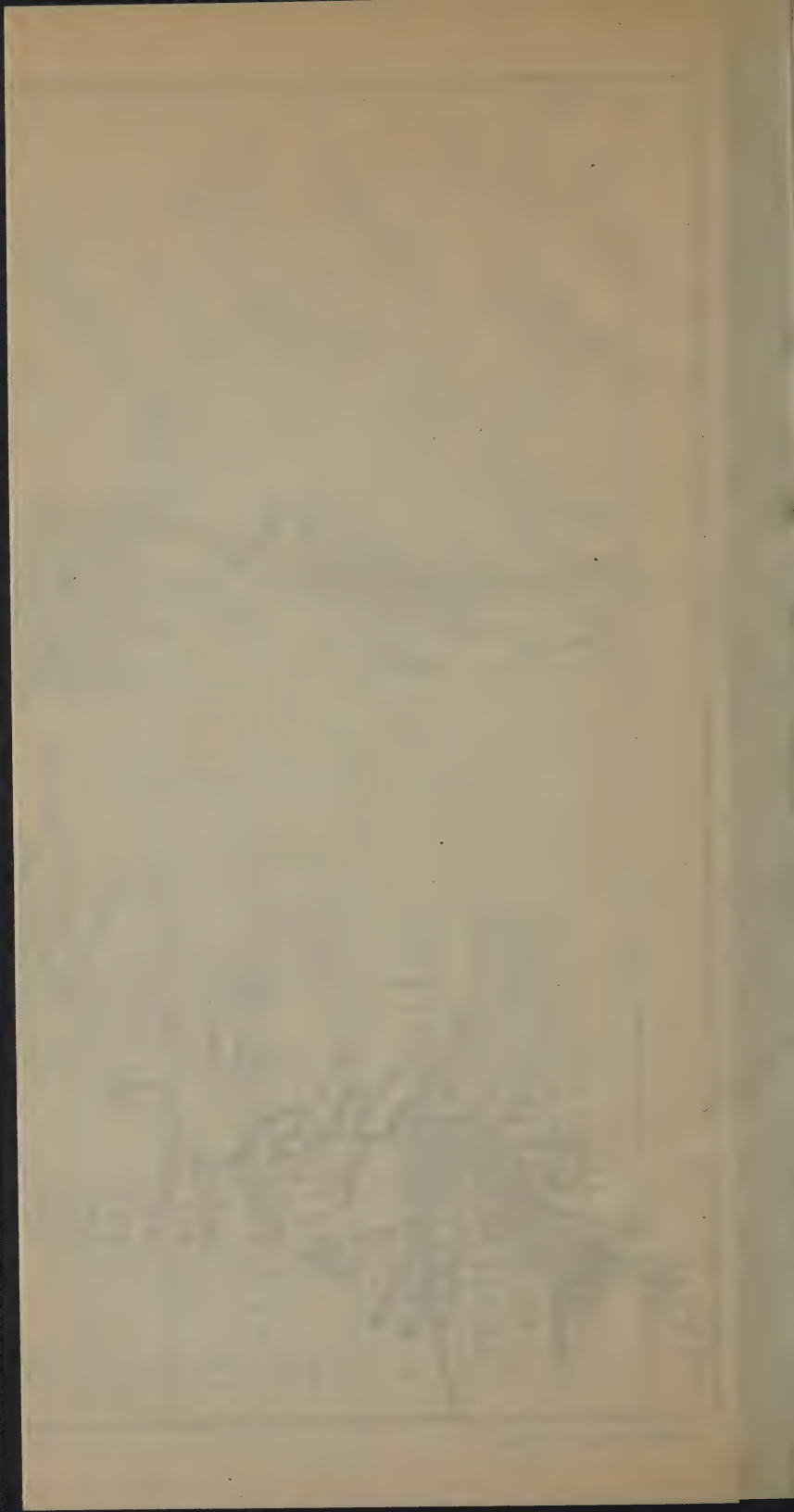
<sup>2</sup>Includes area of Application 581.

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The development of the Sacramento Valley has been so rapid and the problems encountered are so peculiar to the valley that a considerable further study of water problems is necessary. It is believed that the work done so far lays the foundation for the more extensive and intensive study and field investigation which should be in progress during the next several years.









**TABLE 16.**  
Permits Issued on Applications in the Sacramento Valley.  
(Refer to Plate 13, page 100).

Applica- tion No. (1)	Permit No. (2)	Date of receipt of application (3)	Present permittee (4)	Source (5)	Amount of application, second-foot (6)	Amount of permit, second-foot (7)	Acreage of permit (8)
18	29	3/3/15	Compton Delevan Irrigation District.....	Sacramento River and Trough of Colusa Basin.....	110 River 20 Trough 30 River	110 River 20 Trough 30 River	3240. 6
915	452	2/7/18	Compton Delevan Irrigation District.....	Sacramento River and Trough of Colusa Basin.....	110 River 20 Trough 30 River	110 River 20 Trough 30 River	4685. 7
27	31	4/2/15	Reclamation District 1004 (Moulton Water Company).....	Sacramento River.....	31	31	15710. 3
27A	32	4/2/15	B. F. Gould.....	Sacramento River.....	31	31	3378. 7
186	72	11/22/15	Maxwell Irrigation District.....	Sacramento River.....	100	100	(1766)
1598	341	2/28/17	Maxwell Irrigation District.....	Sacramento River.....	100	142	7468
901	432	1/29/18	Maxwell Irrigation District.....	Sacramento River.....	100	100	2977. 2
190	198	11/26/15	Bridget Graham.....	Sacramento River.....	31	31	1104. 7
230	204	1/10/16	Cheney Slough Irrigation District.....	Sacramento River.....	182	162	10683. 7
244	463	2/3/16	Princeton-Codora-Gleim Irrigation District.....	Sacramento River.....	(240)	120	8000
770	464	9/5/17	Princeton-Codora-Gleim Irrigation District.....	Sacramento River.....	240	120	7500
279	92	3/18/16	Emmert and Mumma.....	Reclamation District 108, Drainage Canal (Colusa Basin Water).....	3	3	136. 6
462	303	9/15/16	Provident Irrigation District.....	Sacramento River.....	250	250	(14123)
*640	304	4/9/17	Provident Irrigation District.....	Sacramento River.....	100	100	14123
892	416	1/18/18	Provident Irrigation District.....	Sacramento River.....	110	110	(7609)
41047	494	8/13/18	Provident Irrigation District.....	Sacramento River.....	200	100	8436
479	248	9/23/16	Alicia Mutual Water Company.....	Yuba and Feather River.....	100	100	7152. 3
480	249	9/23/16	Farm Land Investment Company.....	Feather River and Plumas Lake.....	200	150	6463. 9
534	247	12/13/16	Natomas Company.....	Sacramento River.....	50	50	6600
1056	511	8/22/18	Natomas Company.....	Sacramento River.....	60	44. 04	3522. 7
1080	512	8/28/18	Natomas Company.....	Sacramento River.....	8	3	239. 9
1061	513	8/28/18	Natomas Company.....	Sacramento River.....	18	8. 49	838. 9
1203	580	3/5/19	Natomas Company.....	Sacramento River.....	160	160	14510
*545	306	12/26/16	A. K. Harbison.....	Stone Corral Creek.....	3	2	80
571	337	1/20/17	Byron D. Beckwith.....	Sacramento River.....	40	19	737
574	313	1/25/17	River Farms Company.....	Sacramento River.....	5	5	113
575	314	1/25/17	River Farms Company.....	Sacramento River.....	38	38	1838
576	315	1/25/17	River Farms Company.....	Sacramento River.....	180	180	8110
577	316	1/25/17	River Farms Company.....	Sacramento River.....	35	35	1690
581	287	2/1/17	Sutter Basin Company.....	Sacramento River.....	45	45	(7954)
*878	419	1/3/18	Sutter Basin Company.....	Sacramento River.....	120	116. 72	9337
879	420	1/3/18	Sutter Basin Company.....	Sacramento River.....	26	25. 25	2020
880	418	1/3/18	Sutter Basin Company.....	Sacramento River.....	410	410	32545
1160	568	1/24/19	Sutter Basin Company.....	Sacramento River.....	42	40. 5	3240

\*Permit revoked—not included in totals.

†Includes area of Application 186.

‡Includes area of Application 581.

§For same area as Application 462.

¶Includes area of Application 892.



**TABLE 18—Continued.**  
**Permits Issued on Applications in the Sacramento Valley.**  
 (Refer to Plate 13, page 100).

Applica- tion No. (1)	Permit No. (2)	Date of receipt of application (3)	Present permittee (4)	Source (5)	Amount of application, second-foot (6)	Amount of permit, second-foot (7)	Acreage of permit (8)
1756	1101	4/9/20	Sutter Mutual Water Company	Sacramento River	15.93	15.93	1274.5
1757	1102	4/9/20	Sutter Mutual Water Company	Sacramento River	3.53	3.53	798
1758	1103	4/9/20	Sutter Mutual Water Company	Sacramento River	1.80	1.80	120
1759	1104	4/9/20	Sutter Mutual Water Company	Sacramento River	2.00	2.00	160
1760	1105	4/9/20	Sutter Mutual Water Company	Sacramento River	2.00	2.00	160
1761	1106	4/9/20	Sutter Mutual Water Company	Sacramento River	2.40	2.40	191.74
1762	1107	4/9/20	Sutter Mutual Water Company	Sacramento River	14.00	14.00	1120
1763	1108	4/9/20	Sutter Mutual Water Company	Sacramento River	6.00	6.00	480
1764	1110	4/9/20	Sutter Mutual Water Company	Sacramento River	2.00	2.00	160
1765	1111	4/9/20	Sutter Mutual Water Company	Sacramento River	6.00	6.00	480
1767	1112	4/9/20	Sutter Mutual Water Company	Sacramento River	5.50	5.50	440
1768	1113	4/9/20	Sutter Mutual Water Company	Sacramento River	2.50	2.50	200
1769	1117	4/9/20	Sutter Mutual Water Company	Sacramento River	10.00	10.00	800
1770	1118	4/9/20	Sutter Mutual Water Company	Sacramento River	3.13	3.13	250.37
1771	1119	4/9/20	Sutter Mutual Water Company	Sacramento River	0.50	0.50	40
1772	1120	4/9/20	Sutter Mutual Water Company	Sacramento River	1.00	1.00	80
657	338	4/27/17	C. E. Reisdorf	Sacramento River	7.5	7.5	63
*669	335	5/4/17	J. W. Browning	Hamilton Slough	3	3	140
733	343	7/13/17	F. A. Wohlfrom	Sacramento River	20	15.82	1266
735	333	7/14/17	B. F. Mumma	Drainage Canal along back levee of District 108 (Colusa Basin Water)	3	3	180
742	382	7/25/17	Tisdale Irrigation and Drainage Company	Sacramento River	40	29.25	2339.3
763	388	8/27/17	Reclamation District 108	Sacramento River	500	500	30210
771	389	8/27/17	Annie Maxon	Sacramento River	1200	20	1200
866	412	12/2/17	J. E. De Mont	Sacramento River	1	0.95	76
882	423	9/1/18	Knox and Leiser	Sacramento River	10	2.27	181.5
12-316	687	2/9/18	Arizona-Cottonwood Irrigation District	Sacramento River	400	400	32000
840	491	2/9/18	Arizona-Cottonwood Irrigation District	Sacramento River	150	86.7	3468
*868	440	4/13/18	G. H. B. Canoles	Sacramento River	12	12	513
988	654	4/18/18	Avast, Kraker	Hunters Creek	10	1.45	115.8
989	489	5/17/18	F. M. Porter	Sacramento River	7.5	7.5	300.3
1041	542	5/23/18	H. L. Hill, Jr.	Willow Creek (Colusa Basin Water)	15	4.58	366.3
1074	501	8/7/18	Stanford Vina Ranch Irrigation Company	Sacramento River	25	15	1200
1094	518	9/10/18	Alameda Sugar Company	Deer Creek	142	142	8613
*1112	539	9/26/18	F. W. Kiesel	Sacramento River	17	4.19	335
1149	688	10/14/18	California E. Hale	Feather River	10	1.35	108.1
1150	640	12/25/18	Sutter Butte Canal Company	Feather River	500	500	27500
		12/31/18	S. Sweet Company	Borrow Pit of Reclamation District 999	80	80	3698

\*Permit revoked—not included in totals.

**TABLE 16—Continued**  
**Permits Issued on Applications in the Sacramento Valley.**  
 (Refer to Plate 13, page 100.)

Applica- tion No. (1)	Permit No. (2)	Date of receipt of application (3)	Present permittee (4)	Source (5)	Amount of application, second-foot (6)	Amount of permit, second-foot (7)	Acreage of permit (8)
1177	656A	2/13/19	P. N. Ashley	Drainage Canal of District 100	20	15.3	612
1179	609	2/15/19	E. M. Gordon	Sacramento River	40	40	1255.5
1180	564	2/21/19	Fred Van Lew	Sacramento River	10	1.7	135.4
1188	579	3/1/19	T. T. C. Gregory	Sacramento River	20	9.78	782.3
1199	614	3/1/19	Conway Ranch	Sacramento River	120	120	5120
1588	792	12/26/19	Conway Ranch	Sacramento River	200	200	16194
1299	657	5/27/19	S. J. Nunn et al.	Drainage Ditch of Drainage District 100	3.5	3.5	(296.5)
1415	663	8/29/19	S. J. Nunn et al.	Drainage Ditch of Drainage District 100	3.5	3.5	296.5
1413	633	6/5/19	Maude Crouch Moore	Sacramento River	6	6	700
1307	1129	7/27/19	James D. Phelan	Sacramento River	3	3	117
1413	633	6/5/19	Natomas Company of California	Sacramento River	120	120	10004
1422	847	9/2/19	D. A. Middlecamp	Colusa Drain (Colusa Basin Water)	20	3.05	404
1545	868	11/29/19	W. E. Wance	Mooney Slough	15	3.92	584
1554	796	12/3/19	Williams Irrigation District	Sacramento River and Trough of Colusa Basin	187.5	88.27	6681.5
1624	797	1/14/20	Williams Irrigation District	Sacramento River and Trough of Colusa Basin	65	32.01	2301
1655	798	2/5/20	Williams Irrigation District	Sacramento River and Trough of Colusa Basin	11	7.50	109
1592	882	12/29/19	Antonie Quadros	Pine Creek Lagoon and Sacramento River	14	7.47	598
1648	712	1/29/20	Guy H. Lemmon	Drain 5 of S. V. I. Company	3	0.5	40
1656	794	2/5/20	James H. Jones	Hanlin Slough	12	12*	2768
1658	751	2/9/20	W. S. Adams	Drainage Ditch of District No. 1	2.5	0.37	30
1661	1005	2/10/20	Alex L. Gibson and Frances W. Gibson	Pine Creek Lagoon	1.50	1.50	200
1666	884	2/11/20	Holland Land Company	Sacramento River Elk Slough West Levee Borrow Pit	160	160	18000
1701	1135	3/3/20	Maude Crouch Moore	Sacramento River	2.00	2.00	700
1717	778	3/10/20	H. E. Barker	Drainage Ditch of Drainage District No. 1	0.62	0.05	4
1743	992	3/30/20	City of Sacramento	Sacramento River	300	225	Municipal
1753	849	7/31/20	Meek Estate	Sacramento River	50	25.27	(2023)
1932	849	1/3/21	Meek Estate	Sacramento River	50	25.27	2023
2180	872	3/28/21	Thomas W. Madley	Sutter Slough	2.00	0.75	60
2253	381	3/28/21	Edwin W. Euhman	Main Ditch, Drainage District No. 100	6	3.47	277.5
2707	1162	12/29/21	William Dee	Sacramento River	3.57	3.57	286
Totals, 97 permits					6869.68	6137.04	369947.01

\*For same area as Application 1299.

†For same area as Application 1753.

Figures in parentheses have not been used in totals on account of inclusion in other permits.

### APPENDIX III.

#### RETURN WATER IN THE LOWER SAN JOAQUIN VALLEY.

Experience in irrigation development has proved that not all of the water diverted from streams and applied to the irrigation of crops is consumed by the latter or evaporated from the ground surface. A certain amount is lost by seepage from canals and laterals, some by waste from fields and ditches and an additional quantity, on being applied to crops, passes on down below the root zone of the plants, and beyond the depth from which it can again be drawn to the ground surface by capillarity and evaporated.

This water eventually reaches drainage channels, or passes to the water table underlying the irrigated lands, in the latter case either raising it to a point sufficiently near the ground to allow capillarity to again draw it to the surface, or causing a slow underflow towards lower levels. If good drainage does not exist "seepage" of lower lands results from rising water table. If drainage is present, either natural or artificial, a flow of water occurs in the drainage channels.

The importance of the above lies in the fact that where physical conditions permit, a considerable amount of the water diverted and used on the higher lands can be recovered and used again, resulting in an increase in the total acreage which can be irrigated from any given stream.

In many parts of the state water has not become sufficiently valuable as yet to make economically feasible the lining of main canals or laterals, or placing the land in such shape that a minimum quantity only of water need be used, and it is doubtful whether the time will ever come when the value of water used or crops raised will be sufficient to make profitable installation of irrigation systems and preparation of land so that only the actual water consumed by the plants will need to be diverted.

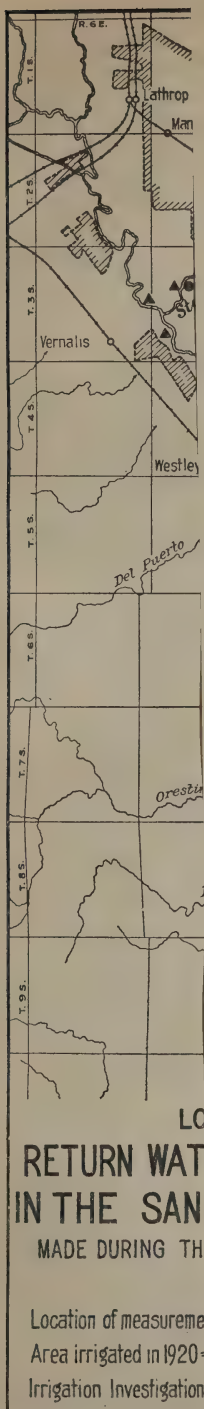
Two methods are generally available for recovering this "return" water, as it is called, by pumping from wells located through the lower areas, or by diversion works located on the drainage or natural channels in which the return water accumulates.

The percentage of the water diverted and used for irrigation of upper lands, which again becomes available, it as yet more a matter of conjecture than of specific knowledge. So many factors and local conditions of soil, crops, climate and topography enter into the situation that results obtained in one locality are seldom applicable to others.

The topography of the great Central Valley of California, particularly that of the San Joaquin Valley, affords an ideal situation for the utilization of return flow. Development in this valley during the last twenty years has resulted in the water of the main streams which enter the valley being entirely diverted during the summer months for irrigation. In spite of this fact, however, a considerable flow occurs in their lower reaches.

The Division of Water Rights has received a number of applications for the appropriation of water for irrigation from the lower portions of these streams, and there are in existence also a number of diversions based upon riparian rights and old rights by appropriation.





### APPENDIX III.

#### RETURN WATER IN THE LOWER SAN JOAQUIN VALLEY.

Experience in irrigation development has proved that not all of the water diverted from streams and applied to the irrigation of crops is consumed by the latter or evaporated from the ground surface. A certain amount is lost by seepage from canals and laterals, some by waste from fields and ditches and an additional quantity, on being applied to crops, passes on down below the root zone of the plants, and beyond the depth from which it can again be drawn to the ground surface by capillarity and evaporated.

This water eventually reaches drainage channels, or passes to the water table underlying the irrigated lands, in the latter case either raising it to a point sufficiently near the ground to allow capillarity to again draw it to the surface, or causing a slow underflow towards lower levels. If good drainage does not exist "seepage" of lower lands results from rising water table. If drainage is present, either natural or artificial, a flow of water occurs in the drainage channels.

The importance of the above lies in the fact that where physical conditions permit, a considerable amount of the water diverted and used on the higher lands can be recovered and used again, resulting in an increase in the total acreage which can be irrigated from any given stream.

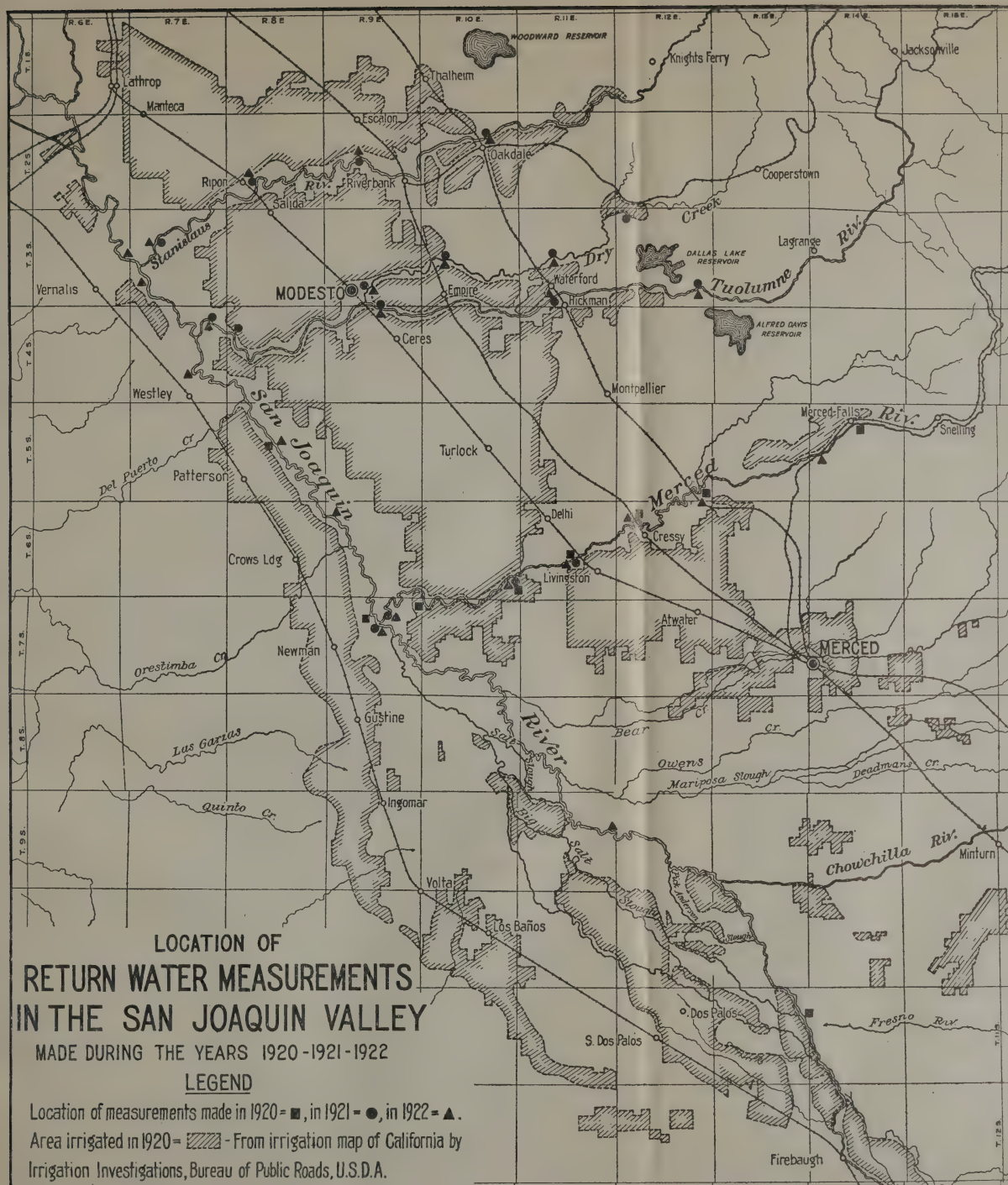
In many parts of the state water has not become sufficiently valuable as yet to make economically feasible the lining of main canals or laterals, or placing the land in such shape that a minimum quantity only of water need be used, and it is doubtful whether the time will ever come when the value of water used or crops raised will be sufficient to make profitable installation of irrigation systems and preparation of land so that only the actual water consumed by the plants will need to be diverted.

Two methods are generally available for recovering this "return" water, as it is called, by pumping from wells located through the lower areas, or by diversion works located on the drainage or natural channels in which the return water accumulates.

The percentage of the water diverted and used for irrigation of upper lands, which again becomes available, it as yet more a matter of conjecture than of specific knowledge. So many factors and local conditions of soil, crops, climate and topography enter into the situation that results obtained in one locality are seldom applicable to others.

The topography of the great Central Valley of California, particularly that of the San Joaquin Valley, affords an ideal situation for the utilization of return flow. Development in this valley during the last twenty years has resulted in the water of the main streams which enter the valley being entirely diverted during the summer months for irrigation. In spite of this fact, however, a considerable flow occurs in their lower reaches.

The Division of Water Rights has received a number of applications for the appropriation of water for irrigation from the lower portions of these streams, and there are in existence also a number of diversions based upon riparian rights and old rights by appropriation.





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With the increase in acreage brought under irrigation through new projects, and the general rise in the water table from irrigation as time goes on, the amount of return flow will increase. In order to allow the Division to act intelligently upon existing applications, it was realized that more information must be obtained relative to the amount, nature and occurrence of this return flow.

Records of the discharge of the main streams entering the valley have been kept at stations located near the foothills, by the water resources branch of the United States Geological Survey, for the last twenty or more years. A few measurements were made during the period 1914 to 1919, under the direction of T. H. Means, consulting engineer of San Francisco, of the flow at various points on the main streams.

In the fall of 1920, a series of measurements were made by the Division on the Merced and San Joaquin rivers; in 1921 and 1922, on the Merced, San Joaquin, Stanislaus and Tuolumne rivers and Dry Creek, tributary to the Tuolumne. In addition to the measurements on the streams themselves all diversions were measured, in order to ascertain the total amount of water which the return flow furnished.

The following table gives a summary of these measurements:

TABLE 17.

Return Flow in San Joaquin Valley Streams During the Years 1920 to 1922.

(Measurements made under the direction of the Division of Water Rights, State Department of Public Works).

Stream	Measurements		Amount flowing, second-feet	Total diversions, second-feet	Total return flow, second-feet
	Date	Location			
Merced River-----	9/12/20	Three miles above San Joaquin River-----	38.6	15.6	54.2
	8/2 and 3/21	One-half mile above San Joaquin River-----	82	1	82
	10/6 and 7/22	One-half mile above San Joaquin River-----	76	32.1	108.1
Tuolumne River-----	9/29/21	One and one-half miles above San Joaquin River-----	342	0	342
	10/2 and 3/22	One and one-half miles above San Joaquin River-----	366	0	366
Dry Creek-----	9/30/21	One-half mile above Tuolumne River-----	39.9	0	39.9
	10/ 3/22	One-half mile above Tuolumne River-----	41.0	0	41.0
Stanislaus River-----	9/28/21	Two miles above San Joaquin River-----	133	0	133
	10/ 4/22	Two miles above San Joaquin River-----	131	15.7	146.7
San Joaquin River--	9/20 to 23/20	One-fourth mile below Patterson Colony Pumping Plant-----	4	170	174
	9/28 to 30/22	Three-fourths mile above Durham Ferry-----	725	148	873

<sup>1</sup>Diversions not noted.

<sup>2</sup>Includes diversions on San Joaquin River only.

The map on Plate 14 shows the locations at which these measurements were made, and also the areas under irrigation in 1920, as given on the irrigation map of Central California, published by the office of Irrigation Investigations, Bureau of Public Roads and Rural Engineering, United States Department of Agriculture.

Plates 15, 16 and 17, show graphically the results of these measurements, and the rate of accretion of flow in the various sections of the stream.

To facilitate interpretation of the results obtained in these measurements, the following remarks are pertinent:

#### **Merced River.**

This stream furnished a total return flow including diversions, varying from fifty-four to one hundred and eight second-feet during the fall of the years 1920 to 1922. The rates of accretion and total flow are relatively small compared with the other streams, due to the smaller irrigated acreage in proximity to the river, and the lesser depth of the channel below the water table of the surrounding lands. A number of pumping plants are installed on the lower reaches, and irrigate adjacent lands.

#### **Tuolumne River.**

This stream runs through the Turlock and Modesto Irrigation Districts and had return flows of three hundred and forty-two and three hundred and sixty-six second-feet in the falls of 1921 and 1922, respectively. The diversion canals of the districts follow the river for a considerable distance below the La Grange diversion dam, and the Davis Reservoir of the Turlock Irrigation District is located near the river channel. These factors account for the high rate of accretion in the upper section of the channel. The increase in rate in the lower portion is caused by drainage ditches entering the channel from the north. The length of time during which irrigation has been practiced in these two districts, the proximity of a large area of irrigated land to the river, and the depth of the channel, cause the amount of return water in this stream to be larger than in any of the others.

#### **Dry Creek.**

This stream runs through the upper irrigated lands on the north side of the Tuolumne River, and had a return flow of about forty second feet.

#### **Stanislaus River.**

The more recent development of irrigated area along this stream, the fact that the canals of the Oakdale and South San Joaquin Irrigation Districts do not follow the river for any great distance, and the small amount of irrigated land in proximity to the lower section of the channel cause the return flow of the Stanislaus to be a little over one-third that of the Tuolumne.

#### **San Joaquin River.**

Measurements made in 1920 and 1921 were not carried below the Patterson Colony diversion, but indicate a considerable return flow above the mouth of the Merced in these years. The total return flow below the mouth of the Stanislaus, in 1922, including diversions totaling one hundred and forty-eight second-feet, amounted to eight hundred and seventy-three second-feet. Subtracting from this amount, the contributions of the Merced, Tuolumne and Stanislaus, totaling 573 second-feet, the net return flow was three hundred second-feet. Most of this accretion occurred below the mouth of the Merced, where the irrigated area lies close to the stream. Continued irrigation, and further development of drainage in the lower lands of the valley may increase the rate of accretion considerably.



# RATE OF ACCRETION OF RETURN FLOW IN MERCED AND STANISLAUS RIVERS

MEASUREMENTS MADE UNDER DIRECTION OF DIVISION OF WATER RIGHTS

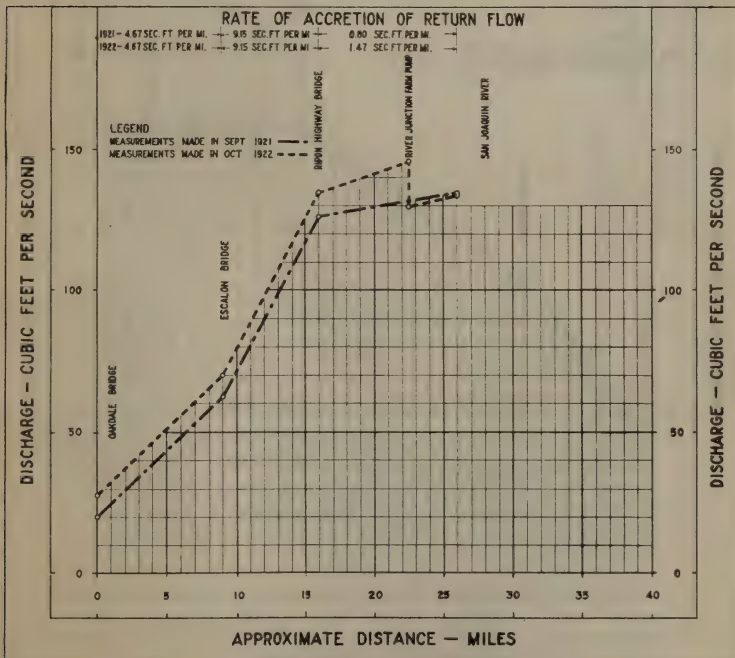
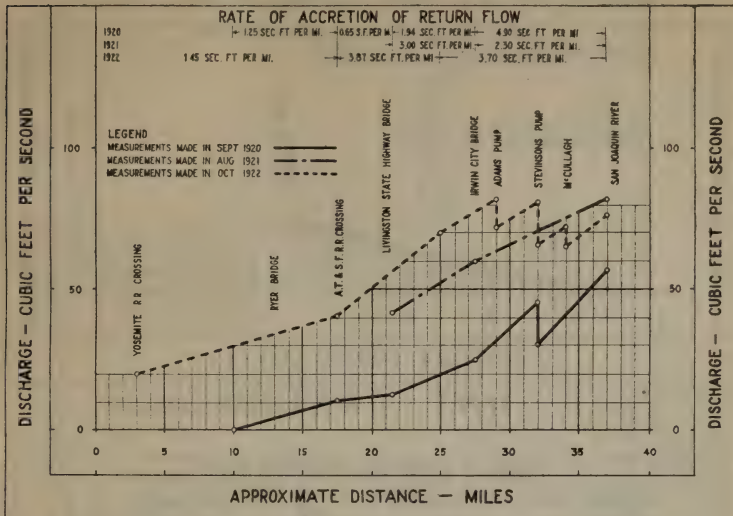
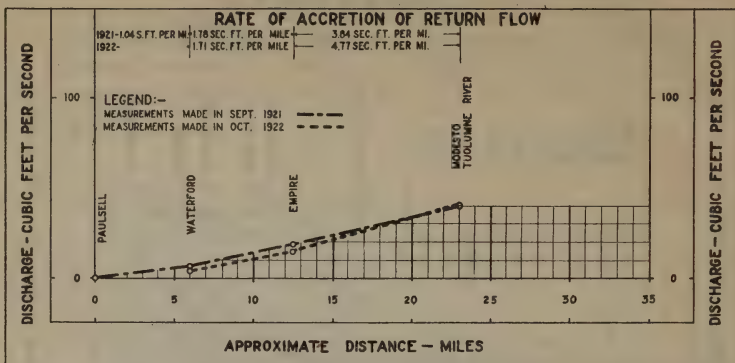


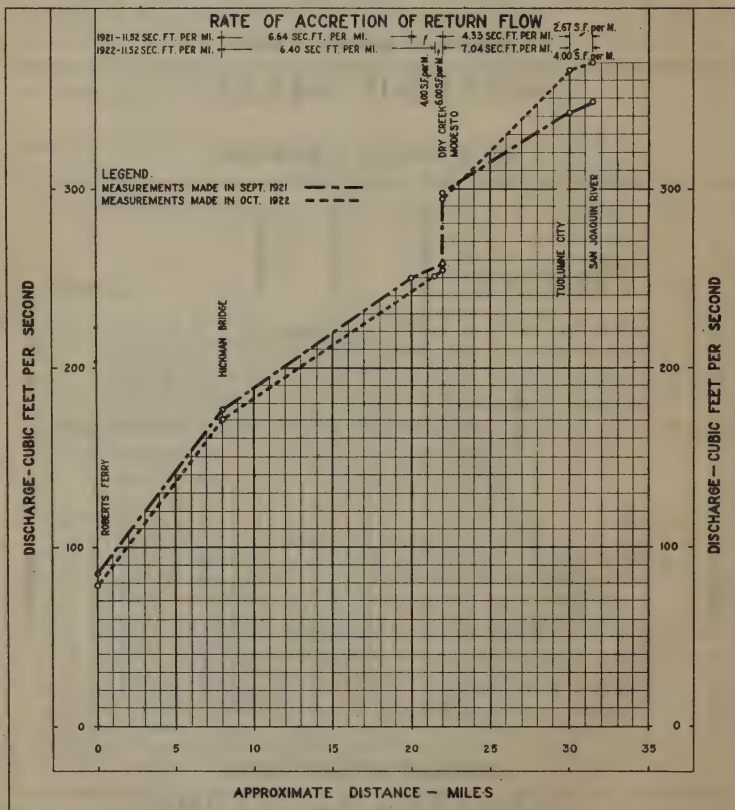
PLATE 15.

# RATE OF ACCRETION OF RETURN FLOW IN DRY CREEK AND TUOLUMNE RIVER

MEASUREMENTS MADE UNDER DIRECTION OF DIVISION OF WATER RIGHTS



## DRY CREEK



## TUOLUMNE RIVER

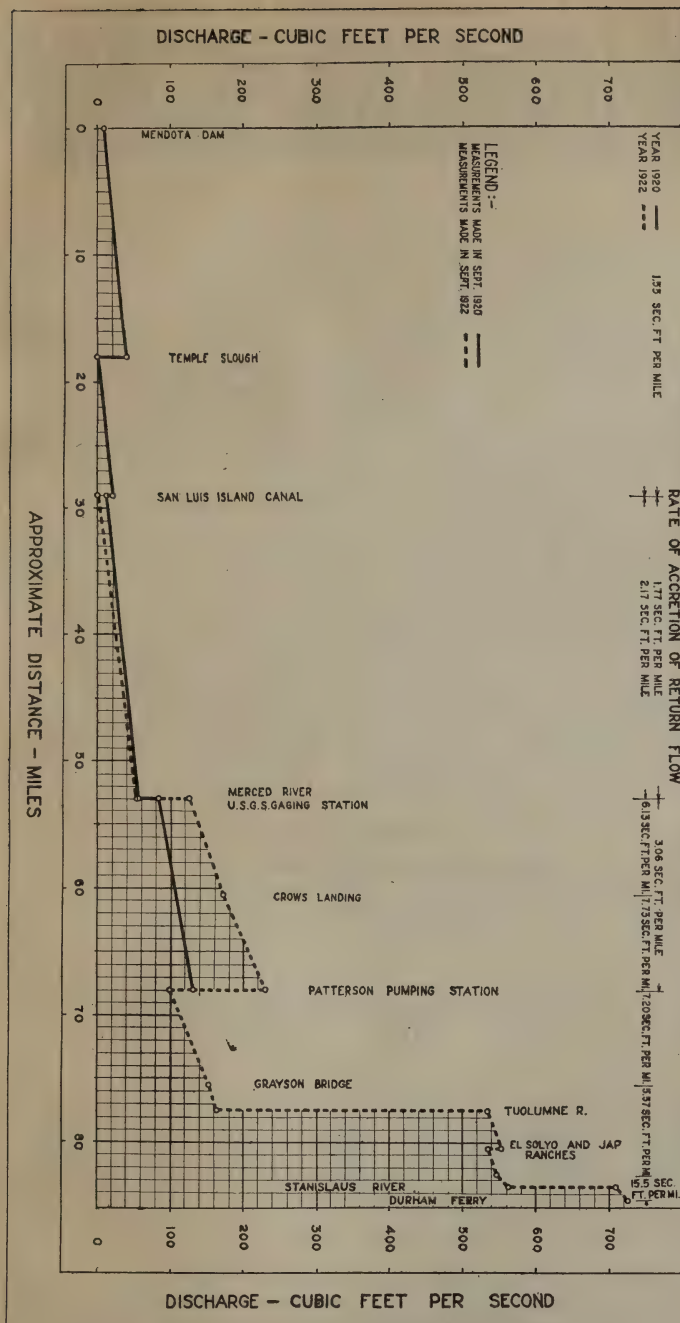


PLATE 17.



On account of the short period during which the investigations have been carried on, no deductions can be drawn as yet, beyond the fact that the amount of return flow is sufficient to make it a factor of greatest importance in the irrigation development in the San Joaquin Valley, and the fact that the rate of accretion in various sections of stream channels appears to remain rather constant from year to year.

# APPENDIX IV.

## REPORT TO THE DIVISION OF WATER RIGHTS, DEPARTMENT OF PUBLIC WORKS, ON THE PROGRESS OF THE COOPERATIVE SURFACE WATER INVESTIGATIONS IN CALIFORNIA BY THE WATER RESOURCES BRANCH OF THE UNITED STATES GEOLOGICAL SURVEY FOR 1921-1922.

By H. D. McGLASHAN, District Engineer, United States Geological Survey.

The cooperative investigation of the surface water resources of the State of California during the years 1921 and 1922 has been maintained on about the same basis as given in your last biennial report except that through cooperation with permittees and licensees of the Federal Power Commission twenty-three new stations have been established. These stations are all located at high elevations and will furnish very valuable run-off records.

As in previous years, the funds furnished by the Division of Water Rights have been expended chiefly in a study of the general water supply of the state. The additional funds available during the past year have permitted more intensive field work, resulting in an increased accuracy in run-off records and the establishment of new stations, chiefly in the drainage basins of Pit River, American River, Kings River, and upper San Joaquin. These records are needed by your office in connection with applications for power and irrigation uses. In addition, special investigations and miscellaneous measurements have been made as requested by your office.

The intensive water resources investigation in southern California, explained in your last report, has been continued and slightly extended.

The amount of work done and its costs, including estimated expenditures for complete records furnished free for publication, for the two-year period ending June 30, 1922, were as follows:

TABLE 18.  
Data as to Measuring Stations in California.

Drainage	Number of stations			Number of discharge measurements			Cost		
	Established	Discontinued	Maintained June 30, 1922	At regular stations	Miscellaneous	Total	Operation and maintenance	New construction	Average cost per station of twelve months record, including new construction, top cost, and office work
Sacramento...	21	0	57	538	88	626	\$11,236 74	\$10,749 78	\$323 18
San Joaquin...	24	0	72	1,666	223	1,889	83,907 49	56,144 18	1,194 36
South Pacific...	11	3	58	2,334	758	3,092	22,661 14	4,779 08	353 76
North Pacific...	3	0	9	122	1	123	2,260 90	1,683 44	337 54
Great Basin...	0	0	14	119	19	138	2,259 84	0 00	123 20
Totals.....	59	3	210	4,779	1,089	5,868	\$122,326 11	\$73,356 48	

In your last report attention was called to the deficient run-off for the years 1917-1920. It appears that the cycle of dry years has not yet been passed. The following table gives the percentage of run-off compared with the 26-year mean, for Sacramento River near Red Bluff and Kings River near Sanger:

TABLE 19.  
Comparative Discharges, Sacramento and Kings Rivers.

River	1917	1918	1919	1920	1921	1922	Mean
	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Sacramento River.....	72	54	79	40	117	65	71
Kings River.....	101	73	64	75	82	117	85

A large amount of additional storage is needed in the Sacramento and San Joaquin drainage basins to conserve the winter run-off which is now wasted into the Pacific Ocean. It appears that there is feasible storage for a considerable amount of the flood waters now being wasted. In connection with the investigation now under way of the unconstructed reservoir capacity in the state, funds should be made available for the installation and maintenance of river measurement stations which will furnish run-off records necessary for the proper design of the dams and other structures.

The following Surface Water-Supply Papers, containing California records, have been published since your last biennial report:

- Paper 447. Surface Water Supply of the Pacific Slope of Southern California, which contains all stream flow records collected in Southern California to September 30, 1918.
- Paper 460. Annual Progress Report of Great Basin for the year ending September 30, 1917.
- Paper 461. Annual Progress Report of California for the year ending September 30, 1917.
- Paper 481. Annual Progress Report of California for the year ending September 30, 1918.

Water-Supply Paper 480, for 1918; 510 and 511, for 1919 and 1920; and 530 and 531, for 1921, are in process of publication. All California records included in these unpublished reports and many complete records for 1922 are now available for distribution upon application to this office. In addition, monthly summaries of stream flow, for all the years of record, have been compiled for all river measurement stations now in operation. These tables are very convenient for the public as many of the Water-Supply Papers are out of print and the latest records are not yet available in printed form.

In the administration of the work of the water resources branch of the Geological Survey, the district office is maintained at 328 Custom House, San Francisco. A sub-office is retained at 602 Federal Building, Los Angeles, for the convenience of southern California and as a headquarters for work in the South Pacific drainage. Records of stream flow for all sections of the United States and data collected by other branches of the survey may be consulted at either office.

The water resources investigation in California is under the general supervision of Mr. N. C. Grover, chief hydraulic engineer, and Mr. John C. Hoyt, hydraulic engineer in charge of surface waters for the Geological Survey.



## APPENDIX V.

### REPORT ON WATER RESOURCES INVESTIGATION.

There was appropriated by the 1921 legislature for the use of the Water Commission a special fund of \$50,000. The text of Chapter 411 creating this fund is as follows:

“Section 1. It shall be the duty of the State Water Commission to make such investigations of the water resources of the State of California, as may be necessary for the purposes of securing information needed in connection with applications for appropriations of the waters of the State of California made before said state water commission.

“Section 2. The sum of fifty thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any money in the state treasury not otherwise appropriated to be expended by the State Water Commission in carrying out the purposes of this act.”

The funds available under this appropriation have been and are being expended by the Division of Water Rights in the collection of general data necessary for action on applications, and for the direct investigation of the same, which work is fully described in other chapters of this report. The particular items, the expense of which have been defrayed from this fund are as follows:

Cooperation to the extent of \$10,000 per year with the United States Geological Survey in the collection of stream-flow records. (Chapter VI).

Special Investigations—San Jacinto, Kings, San Joaquin rivers, etc. (Chapter V).

Field investigation of applications as described in “Field Procedure” in Chapter II. This item has been only partially met from this appropriation.

The income and expense from this fund to date is included in the financial statement in Appendix VI.

# APPENDIX VI.

## FINANCIAL STATEMENT.

### STATE WATER COMMISSION AND DIVISION OF WATER RIGHTS.

Statement of Income and Expenditures for the Seventy-second and Seventy-third Fiscal Years.

	72d and 73d fiscal years, July 1, 1920- July 29, 1921	73d fiscal year, July 29, 1921- June 30, 1922	Total for biennium
<b>Income.</b>			
Appropriations—			
Salaries of Commissioners—Chapter 645, 1919, and Chapter 13, 1921	\$19,605 76	\$389 75	\$19,995 51
Support—Chapter 645, 1919	55,762 11		55,762 11
Support—Chapter 905, 1921	7,590 64	71,280 79	78,871 43
Survey Water Resources—Chapter 411, 1921	2,330 00	20,035 03	22,365 03
Treasury Revolving Fund—Chapter 854, 1921		416 07	416 07
Totals	\$85,288 51	\$92,121 64	\$177,410 15
Contributive Funds—			
Niles Cone Fund	\$109 93		\$109 93
San Joaquin Hydrographic Investigation Fund	5,517 15	\$2,407 01	7,924 16
City of San Luis Obispo Fund		500 00	500 00
San Jacinto Fund		1,502 37	1,502 37
Totals	\$5,627 08	\$4,409 38	\$10,036 46
Grand total income	\$90,915 59	\$96,531 02	\$187,446 61
<b>Expenditures.</b>			
Appropriations—			
Administration	\$35,812 00	\$23,511 45	\$59,323 45
Applications	36,223 50	48,801 59	85,025 09
Adjudications	7,330 45	7,166 13	14,496 58
Stream Gaging—Cooperative U. S. Geological Survey	4,927 31	9,729 63	14,656 94
Cooperative U. S. Department of Agriculture	995 25		995 25
San Jacinto Fund—Chapter 411, 1921		2,912 84	2,912 84
Totals	\$85,288 51	\$92,121 64	\$177,410 15
Contributive Funds—			
Niles Cone Fund	\$109 93		\$109 93
San Jacinto Fund		\$1,502 37	1,502 37
City of San Luis Obispo Fund		500 00	500 00
San Joaquin Hydrographic Investigation Fund	5,517 15	2,407 01	7,924 16
Totals	\$5,627 08	\$4,409 38	\$10,036 46
Grand total expenditures	\$90,915 59	\$96,531 02	\$187,446 61
Fees collected and credited to General State Fund	\$16,660 70	\$16,958 41	\$33,619 11

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## APPENDIX VII

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### STATISTICAL TABLES

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TABLE NO 20.

**Important Proposed Irrigation Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 500 acres or more are listed by name. Projects of less than 500 acres, including domestic and industrial applications, are shown as a single group at the end of the table.  
Cancelled filings are not included.

Name of applicant	Appli- cation number	County	Source of supply	Amount of water		Acres to be irrigated	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
H. R. Peckham.....	2000	San Diego	Pauma Creek.....	10.00	12,000	5,000	\$100,000
E. B. Meyers.....	2002	Colusa	Sacramento River.....	5.19	---	519	10,000
Yuba Development Company.....	2004	Yuba	Yuba River.....	---	20,000	10,000	3,500,000
J. G. Hooper, Jr.....	2016	Lassen	Long Valley Creek.....	---	17,000	3,273	216,000
J. J. Greave et al.....	2019	Siskiyou	Jenny Creek.....	5.25	---	500	2,000
I. B. Thompson.....	2029	Butte	Butte Creek.....	140.00	100,000	100,000	---
Foothill Irrigation District.....	2042	Fresno	Kings River.....	300.00	100,000	100,000	---
H. R. Peckham.....	2055	San Diego	West Fork San Luis Rey River.....	1,000.00	12,000	57,500	50,000
Merced Irrigation District.....	2062	Merced	Burns Creek.....	22.00	---	200,000	---
F. L. Fehren.....	2083	Santa Clara	Lajas Creek.....	6.67	---	1,800	20,000
J. P. Vmet.....	2086	San Joaquin	Lone Tree Creek.....	6.70	---	533	5,000
P. T. Williamson.....	2091	San Joaquin	San Joaquin River.....	---	---	536	3,000
H. M. Roberts.....	2093	Merced	Antelope Flat Drainage Area.....	---	2,635	501	4,000
W. J. Hole.....	2096	Riverside	Drainage Area.....	9.00	---	1,252	---
M. I. Crocker et al.....	2099	Amador	North Fork Mokelumne River.....	---	60,000	66,000	---
Santa Clara Valley Water Conservation Committee.....	2103	Santa Clara	Arroyo Colorado.....	30.00	8,000	---	---
Santa Clara Valley Water Conservation Committee.....	2104	Santa Clara	Lajas Creek.....	50.00	15,000	---	---
Santa Clara Valley Water Conservation Committee.....	2105	Santa Clara	Uvas Creek.....	80.00	25,000	150,000	---
Santa Clara Valley Water Conservation Committee.....	2106	Santa Clara	Alamo Creek.....	30.00	6,000	---	---
Santa Clara Valley Water Conservation Committee.....	2109	Santa Clara	Coyote River and Los Animas Creek.....	200.00	120,000	---	---
O. Scribner.....	2121	Eldorado	Dry Creek.....	276.00	---	130,000	---
Excelsior Water and Power Company.....	2122	Amador	Squirrel Creek.....	145.00	20,000	45,000	---
Excelsior Water and Power Company.....	2126	Nevada	Deer Creek.....	225.00	150,000	120,000	36,000
Excelsior Water and Power Company.....	2130	Nevada	South Fork of Yuba River.....	125.00	60,000	---	3,025,000
Santa Clara Valley Water Conservation Committee.....	2131	Nevada	Calabaass Creek.....	20.00	1,500	---	2,634,000
Santa Clara Valley Water Conservation Committee.....	2136	Santa Clara	Guadalupe Creek.....	50.00	6,000	---	---
Santa Clara Valley Water Conservation Committee.....	2137	Santa Clara	Stevens Creek.....	80.00	7,000	150,000	---
W. H. Baymiller for El Camino Irrigation District.....	2138	Santa Clara	Underground water.....	---	---	---	---
Oroville-Yandotte Irrigation District.....	2140	Tehama	Lost Creek.....	50.00	45,000	7,561	461,630
Oroville-Yandotte Irrigation District.....	2142	Butte	Slate Creek.....	---	100,000	31,650	---
Oroville-Yandotte Irrigation District.....	2144	Yuba	Dry Creek.....	---	5,000	17,000	---
Oroville-Yandotte Irrigation District.....	2145	Eldorado	South Fork American River and Webber Creek.....	330.00	20,000	31,650	---
R. E. Hawley.....	2146	Yuba	Klamath.....	---	150,000	---	3,500,000
R. E. Stewart, Klamath-Shasta Valley Irrigation District.....	2149	Klamath County, Ore.	Lakea and creeks tributary to So. Bishop Creek.....	---	4,544	40,000	---
I. C. Hall.....	2152	Inyo	---	---	---	3,240	40,000

R. E. Fairchild	2166	San Bernardino	Santa Ana River and Forsee Creek	50.00	15,000	300,000
C. F. Taylor et al.	2186	Plumas	Bucks Creek	8.00	70,000	300,000
San Diego Mutual Water Company	2188	San Diego	Escondido Creek	8.00	12,011	250,000
R. H. Edgett	2196	Yuba	South Fork of North Fork, Yuba River	500.00	79,100	2,250,000
W. Nunn	2201	Fresno	Big Panache Creek	50.00	250,000	150,000
Excelsior Water and Power Company	2202	Sierra and Nevada	Middle Fork Yuba River	50.00	120,000	1,600,000
Excelsior Water and Power Company	2206	Nevada	Middle Fork of Middle Yuba River	75.00	30,000	41,500
Honcut-Yuba Irrigation District	2208	Butte	Wyman Ravine	75.00	2,000	2,500
Honcut-Yuba Irrigation District	2209	Butte	South Honcut Creek	75.00	2,500	2,500
Honcut-Yuba Irrigation District	2210	Butte	North Honcut Creek	150.00	30,000	3,000,000
United States Reclamation Service	2212	Tehama	Stony Creek and tributaries	5,000	7,000	25,000
T. Pearson for proposed Mazalia Irrigation District	2215	Butte	Little Butte Creek	10,000	3,000	100,000
T. Pearson for proposed Mazalia Irrigation District	2216	Butte	Little West Branch of Feather River	150.00	90,000	1,100
Water Conservation Association	2217	San Bernardino	Santa Ana River	40.00	2,500,009	2,500,009
R. C. Hackley	2219	Plumas	Grizzly Creek	10.00	700	449,000
R. B. Marshall	2220	Stanislaus	San Joaquin River	140,260	85,000	500,000
Walker River Irrigation District	2221	Mono	West Walker River	115,000	35,000	500,000
Walker River Irrigation District	2222	Mono	West Walker River	7,100	6,100	6,100
Walker River Irrigation District	2223	Mono	Coyote Flat	125,000	3,640	250,000
C. W. Clark Company	2227	Lassen	Big Rock Creek	50.00	635	7,500
J. A. Trow	2231	Los Angeles	Underground stream	250.00	20,000	31,628
T. G. Carpenter	2232	Riverside	Antelope and Butte Creeks	28.00	5,581	32,000
Butte Valley Irrigation District	2234	Siskiyou	West Branch Feather River	15.00	123	6,500,000
M. J. Howells for Thermalito and Table Mountain Irrigation Districts	2240	Butte	Dead Man's Canyon	500.00	50,000	2,500,000
Little Baldy Water Company	2242	Los Angeles	Canyon Creek	4.00	50,000	2,000,000
Excelsior Water and Power Company	2243	Nevada	Middle Fork Feather River	850	5,000	197,000
R. C. Hackley	2253	Butte	West Fork Carson River	150.00	70,000	1,030,000
G. M. Trent	2259	Alpine	Headwaters Singleton Creek	195.00	25,000	78,134
Moreno Mutual Irrigation Company	2260	Riverside	Headwaters Singleton Creek	400.00	75,000	215,000
Eldorado County Irrigation Committee	2261	Riverside	N. Fk. Cosumnes River, Camp and Park Creeks	50.00	850	5,000
Eldorado County Irrigation Committee	2270	Eldorado	N. Fk. Cosumnes River, Camp and Clear Creeks	100.00	8,350	350,000
J. E. Taylor et al. for Nevada Irrigation District	2271	Eldorado	N. Fk. Cosumnes River, Camp and Clear Creeks	16.00	12,322	30,000
J. E. Taylor et al. for Nevada Irrigation District	2273	Sierra	South Fork of North Yuba River	37,700	18,000	1,370,000
J. E. Taylor et al. for Nevada Irrigation District	2276	Nevada	Middle Fork Yuba River	600.00	64,908	64,908
J. E. Taylor et al. for Nevada Irrigation District	2277	Nevada	South Fork of Middle Yuba River	8.00	1,233	1,233
J. E. Taylor et al. for Nevada Irrigation District	2278	Nevada	Deer Creek	100.00	22,170	31,628
I. B. Parsons	2285	Yolo	Borrow Pit Reclamation District No. 999	52,000	29,720	10,000
A. O. Stewart	2286	San Joaquin	Barge Canal	18,000	12,502	65,000
C. E. Hutchinson et al.	2296	Sacramento	Cosumnes River	16.00	30,000	10,000
San Diego Mutual Water Company	12-2315	Sacramento	San Joaquin River	168.00	13,748	13,748
Felix Swan for East Dixon Irrigation and Drainage Association	2318	Solano	San Joaquin River	7,500	7,500	650,000
Folsom State Prison	2322	San Diego	Sacramento River	2,000	2,000	20,000
Butte Valley Irrigation District	2326	Placer	South Fork American River	1,499	1,499	80,000
Butte Valley Irrigation District	2336	Siskiyou	Bear Creek	100.00	2,000	2,000
H. and S. Albright	2338	San Bernardino-Riverside	Whitewater River, Talquitz and Palm Canyon Creeks	52,000	29,720	10,000
Lake Hemet Water Company	2341	San Bernardino-Riverside	Whitewater River, Talquitz and Palm Canyon Creeks	18,000	12,502	65,000
E. H. Libby	2344	Riverside	Strawberry Creek	10,000	10,000	10,000
West Stanislaus Irrigation District	2349	Los Angeles	Pallet and Big Rock Creeks	168.00	13,748	13,748
Little Rock Power and Water Company	2352	Stanislaus	San Joaquin River	7,500	7,500	650,000
J. C. Knowles	2360	Los Angeles	Little Rock Creek	2,000	2,000	20,000
J. C. Knowles	2361	Napa	Trout Creek	1,499	1,499	80,000
J. C. Knowles	2361	Napa	Horseshief Creek	1,000	1,000	80,000

**TABLE NO. 20—Continued.**

**Important Proposed Irrigation Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

Norz.—All projects of 500 acres or more are listed by name. Projects of less than 500 acres, including domestic and industrial applications, are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Applica- tion number	County	Source of supply	Amount of water		Acres to be irrigated	Estimated cost
				Natural flow, second-foot	Storage, acre-feet		
Great Western Power Company	2368	Butte, Plumas	Feather River and Bucks Creek	124.00	18,400		
Great Western Power Company	2371	Butte, Plumas	Feather River and Rock, North Valley, Little Rock and Crane Valley Creeks.	162.00	24,800	30,000	4,300,000
F. H. Tibbetts for Nevada Irrigation District	2373	Nevada	South Yuba Creek	180.00	50,000		
G. M. and J. E. Clark	2385	Modoc	Humper Gulch		1,270	578	15,000
E. P. Vandercook for proposed Feather River Irrigation District	2387	Butte, Plumas	Feather River, Nelson, North Valley, Indian, Little Kingsley, Kingsley Rock Pond, Chips, Soda, Grizzly and Taylor Creeks and Cham- bers, Spring Valley, Campbell, Lotts, Morris and unnamed (3) lakes.	250			
Honcut-Yuba Irrigation District	2393	Yuba	Yuba River	1,000.00	160,000	20,000	
J. E. White	2401	Ventura	Ventura River	10.00	20,000	31,500	
Los Verjels Land and Water Company	12-2406	Yuba	Dry Creek	275.00		26,000	
A. L. Landis	2408	Sacramento	Laguna Creek	5,000.00	15,000	5,675	
A. L. Landis	2409	Amador	Mokelumne River	11,000.00	800,000		
A. L. Landis	2410	Sacramento	Dry Creek	17,000.00	200,000		15,000,000
A. L. Landis	2411	Amador	Cosumnes River	7,000.00	400,000		
M. J. Howells for Thermalito and Table Mountain Irrigation Dis- trict	2417	Butte	Dry Creek	15.00	12,000	11,000	175,000
San Dimas Land and Water Company	2418	Los Angeles	Rush Creek	500.00	44,670	620	
Serra Land and Water Company	2432	Mono	Rush Creek	44.045		44,045	637,152
City of Wilkeson	2434	Butte	Feather River	40.00		5,000	
Watson Brothers, Incorporated	2445	Inyo	Bishop Creek, North, Long and Unnamed Lakes	250.00	20,000	5,000	
M. C. Seagrave	2452	Eldorado	North Fork Cosumnes River	100.00		15,000	250,000
W. S. D. Seagrave for proposed Irrigation District	2454	Solano	Suisun Creek	200.00	10,000	20,640	
Temescal Water Company	2473	Riverside	Indian Creek		2,000		
Temescal Water Company	2474	Riverside	Horseshief Canyon Creek	5.00	2,000	5,000	12,000
Temescal Water Company	2475	Riverside	Mayhew Creek	10.00	3,000		
Temescal Water Company	2476	Riverside	Cold Water Creek		4,000		
W. Neumann et al.	2482	San Benito	San Benito River, James, Rock Springs, Salt, Tres Pinos and eight unnamed creeks.		302,000	150,000	
W. Neumann et al.	2483	San Benito	Lewis and eight unnamed creeks		100,000		
W. Neumann et al.	2484	San Benito	Los Aquilas and four unnamed creeks		56,000		
W. Neumann et al.	2485	Fresno	Little Panoche Creek	250.00	25,000		
O. H. Cash, trustee Perris Valley Chamber of Commerce	2507	Riverside	Potrero Creek	8.00	6,000	4,600	495,000



2508	Sierra.....	Dog Creek.....	8,000	2,000	138,575
2512	Sutter.....	Feather River.....	36,000	620	15,000
2514	Calaveras.....	Stanislaus River.....	10,000	71,081	500,000
2524	Nevada.....	Deer Creek.....	625.00	120,000	2,194,000
2527	Siskiyou.....	Butte Lake.....	275.00	31,628	50,000
2531	Anador, Calaveras.....	North Fork Mokelumne River.....	2,000.00	200,000	10,000,000
2535	Placer.....	Calaveras and Mokelumne Rivers.....	2,000.00	60,000	800,000
2556	Beekman and Linden Engineering Corporation.....	Bear River.....	500,000	300,000	800,000
2564	Bear River Water and Power Company.....	Owens River.....	2,000.00	70,000	300,000
2568	W. D. McPherson, proposed irrigation district.....	Rush Creek.....	750.00	300,000	500,000
2569	W. D. McPherson, proposed irrigation district.....	Underground waters of Mono Lake.....	2,500.00	40,000	100,000
2570	W. D. McPherson, proposed irrigation district.....	Lee Vining and Mill Creeks.....	69.00	3,442	1,500
2571	W. D. McPherson, proposed irrigation district.....	North Fork Ventura River.....	6.00	8,160	1,500
2572	Leeds and Barnard for Irrigation District.....	Stanislaus and San Joaquin Rivers.....	40.00	20,000	20,000
2573	River Junction Farms, Incorporated.....	Butte Creek.....	250.00	15,000	15,000
2576	J. H. Jones.....	Mojave River.....	100.00	20,000	20,000
2579	F. S. Lewis et al., proposed Harvard Irrigation District.....	American River.....	10.00	6,000	40,000
2580	A. J. Cleary, proposed Roseville Irrigation District.....	Deep Canyon, Pinon Flats and Dead Indian Creeks.....	6.48	518	2,000,000
2581	N. B. Stadley et al.....	Matilija Creek.....	200,000	40,000	200,000
2582	J. E. White.....	Channel connecting Rock and Indian Sloughs.....	100.00	10,000	10,000
2593	H. L. Hill, Jr.....	Rubicon River and Middle F.E. American River.....	600.00	40,000	40,000
2613	F. B. Tuttle, Jr.....	Salmon Creek.....	100.00	200,000	200,000
2617	W. C. Howe et al.....	North Fork and Strawberry Creeks.....	200.00	90,000	25,000
2620	H. L. Thompson, Hemet Irrigation District.....	Bear River.....	2,500.00	75,000	75,000
2626	J. A. Livingston for Mt. Pleasant-Lincoln Irrigation District.....	San Diego River.....	1,000.00	700,000	1,500,000
12-2641	Ed. Fletcher et al.....	American River.....	3.00	10,500	1,500,000
2642	A. J. Cleary, proposed Roseville Irrigation District.....	Dexter, Lee Vining, Gibbs, Rush, Walker, Wilson, Parker and Mill Creeks.....	10,500	16,016	5,000
2646	J. C. Working and R. L. Gilmore.....	Flood waters of Bear River.....	1,500	600	1,250,000
2652	Nevada Irrigation District.....	Pallett Creek.....	44,225	720	250,000
2659	H. C. Dunn, trustee for Pallett Creek Water Users Association.....	Bacoma Creek.....	16,000	11,000	150,000
2671	Los Angeles County Flood Control District.....	Coyote Valley Drainage Area.....	1,829	8,000	1,750,000
2672	Los Angeles County Flood Control District.....	San Diego River.....	22,000	8,500	150,000
2689	F. D. Harbert.....	San Diego River.....	15,000	100,000	50,000
2695	Ed. Fletcher.....	Coyote Valley Drainage Area.....	2,999	745	20,000
2699	F. C. Springmeyer.....	West Fork Owens River.....	710	25,000	600,000
2703	F. M. Howells.....	Clear and Gold Run Creek Watersheds.....	250.00	8,000	500,000
2706	F. M. Turner for Bangor Irrigation District.....	Butte.....	60.00	1,500	1,000
2708	F. M. Howells.....	Yuba.....	3,945	730	25,000
2716	F. M. Turner for Bangor Irrigation District.....	Matilija Creek.....	250.00	20,000	1,500
2726	Can Irrigation Company.....	North Fork Ventura River.....	18.75	5.00	
2728	Leeds and Barnard for Irrigation District.....	San Benito River and Tres Pinos Creek.....			
2732	C. A. Stewart.....	North Fork American River.....			
2734	C. A. Tusho.....	Middle Fork Bishop Creek.....			
2737	F. P. Tuttle, Jr.....	Green Lake Creek.....			
2738	Hillside Water Company.....	Yuba River and Dry Creek.....			
2739	Hillside Water Company.....	Yuba River and Dry Creek.....			
2741	H. L. Berkeley.....	Santa Ana River.....			
2745	Temescal Water Company.....	Sacramento River.....			
2748	Finnel Land Company.....	Pascadero Creek.....			
2760	Peninsula Farms Company.....				

**TABLE NO. 23—Continued.**

**Important Proposed Irrigation Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 500 acres or more are listed by name. Projects of less than 500 acres, including domestic and industrial applications, are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Appli- cation number	County	Source of supply	Amount of water		Acres to be irrigated	Estimated cost
				Natural flow, second-foot	Storage, acre-foot		
A. L. Conard for proposed irrigation district.....	2763	Tehama	Elder Creek	250.00	100,000	40,000	---
A. L. Conard for proposed irrigation district.....	2764	Tehama	Red Bank Creek	200.00	75,000	30,000	---
A. L. Conard for proposed irrigation district.....	2765	Tehama	South Fork Cottonwood Creek	100.00	75,000	30,000	---
A. L. Conard for proposed irrigation district.....	2766	Tehama	Thomas Creek	250.00	125,000	50,000	---
I. H. Parker.....	2772	Placer	Bear River	---	60,000	---	---
Preston School of Industry.....	2774	Amador	Sutter Creek	8.30	3,750	664	\$75,000
G. H. V. Land Company.....	2777	Butte	Butte Creek and Hamlin Slough	15.00	---	2,338	2,750
Oroville-Wyandotte Irrigation District.....	2778	Butte	Lost Creek	50.00	25,000	---	---
W. Neumann.....	2779	San Benito	Silver Creek	250.00	---	150,000	---
F. H. Dan.....	2794	Yuba, Nevada	Dry Creek and North Fork Wolf Creek	---	110,000	28,000	1,000,000
Hillside Water Company.....	2799	Inyo	Bishop Creek	20.00	---	3,945	25,000
Sacramento-San Joaquin Bank.....	2800	Fresno	Waltham, Canvas, Cantua, Jacalitos, White, Arroyo Hondo, Zapato, Los Gatos and Salt Creeks.	---	500,000	---	---
E. L. Adams et al.....	2805	Butte	Butte Creek	14.00	---	1,215	1,500
Thebo, Starr and Anderton, Incorporated.....	2810	Eldorado	South Fork American River	1,500.00	500,000	400,000	5,000,000
Jas. P. Sweeney.....	2821	Calaveras	Mokelumne River	500.00	400,000	200,000	---
R. L. Morehead.....	2824	Sutter	Sutter Butte By-Pass	9.08	---	728	---
Oroville-Wyandotte Irrigation District.....	2825	Butte	South Hound Creek	50.00	25,000	30,000	200,000
H. H. Barr.....	2828	Plumas	Clover Creek	---	90,000	---	---
G. P. McCorkle.....	2831	Los Angeles	Big Rock Creek	---	12,000	30,000	250,000
J. B. Morrison.....	2836	Napa	Putah Creek	---	150,000	50,000	---
J. B. Morrison.....	2837	Lake, Yolo	Putah Creek	400.00	50,000	30,000	---
E. I. Lane.....	2841	Plumas	Last Chance Creek	---	30,000	12,000	30,000
E. E. Daley.....	2843	Imperial	New River	129.93	---	520	1,000
A. G. Lyon.....	2848	Modoc	Cottonwood Creek	3.00	---	23,515	750,000
Red Rock Creek Irrigation District.....	2855	Lassen	Cold Spring, Buckhorn, Red Rock and Painter Creeks.	---	150,000	630	1,600
R. H. and A. J. Anklin.....	2856	Modoc	Canyon Creek	---	1,000	100,000	---
C. E. Pollock.....	2873	Amador	Cosumnes River	400.00	200,000	50,000	---
E. I. Lane.....	2876	Sierra	Little Truckee River and Webber Lake	100.00	100,000	5,000	350,000
J. J. Livingston for Irrigation District.....	2881	Yuba	Bear River	---	65,000	20,200	---
J. J. Livingston et al.....	2883	Lassen	Willow Creek	---	5,000	31,628	940,000
Butte Valley Irrigation District.....	2892	Siskiyou	Butte Lake	---	3,000	---	---
Paradise Irrigation District.....	2894	Butte	West Branch Feather River	---	---	---	---

Project Name	Year	Place	Project Description	Estimated Cost	Actual Cost	Balance
Bear River Water and Power Company.	2901	Siskiyou	Lake, Six Mile and Wilson Valleys.	25,000	15,000	10,000
W. D. Duke.	2904	Ventura	Shasta River and Parks Creek.	8,000	22,000	1,000,000
B. E. Gabbett.	2905	Sacramento	Matilija Creek.	810	10,000	1,000
F. Tade et al.	2907	Butte	Snodgrass Slough.	1,600	20,000	2,000
H. W. Whitten.	2909	San Bernardino	Butte Creek.	8,000	94,500	200,000
Temescal Water Company.	2915	Riverside	Santa Ana River.	3,000	9	25,000
Coachella Valley County Water District.	2922	Riverside	Whitewater River and 24 tributaries.	10,000	175,000	60,000
A. G. Arnold, Tia Juana River Irrigation District.	2925	San Diego	Underground waters Tia Juana River.	10,000	37,500	1,700
Temescal Water Company.	2936	Riverside	San Jacinto River.	10,000	20,000	150,000
E. E. Holbrook, Hollister Irrigation District.	2937	San Benito	San Benito River, Tres Pinos, Quien Sabe, Pa- ciego and Los Muertos Creeks.	800.00	35,000	
East Lugonia Mutual Water Company.	2938	San Bernardino	Mill Creek.	10.00	10.00	
M. C. Seagrave.	2942	Eldorado	Deer Creek.	10.00	35,000	
M. C. Seagrave.	2943	Eldorado	Cosumnes River.	10.00		
Reclamation District No. 756.	2948	San Joaquin	San Joaquin, Mokelumne, South Fork Mokel- umne Rivers and Potato Slough.	75.00	6,006	
Reclamation District No. 2024.	2949	Contra Costa	Dredger Cut.	14.00	1,120	
Reclamation District No. 2024.	2950	Contra Costa	Old River, Indian Slough, and Dredger Cut.	28.72	2,369	
Reclamation District No. 2025.	2951	Contra Costa	Sand Mound Slough and Dredger Cut to Old River.	53.43	4,275	
Reclamation District No. 2026.	2952	Contra Costa	San Joaquin, False and Old Rivers, Dredger Cut and Indian Slough.	68.02	5,522	
Reclamation District No. 2027.	2953	San Joaquin	San Joaquin, Middle and Old Rivers and Dredger Cut.	67.57	5,406	
Reclamation District No. 2028.	2954	San Joaquin	Old River and connecting slough to Middle River.	70.24	5,625	
Reclamation District No. 2029.	2955	San Joaquin	San Joaquin River and Little Connection, Po- tato, White and Disappointment Sloughs and Hunker Cut.	45.98	3,678	
Reclamation District No. 2030.	2956	San Joaquin	San Joaquin and Middle Rivers, Whiskey and Latham Sloughs and Empire Cut.	76.36	6,109	
Reclamation District No. 2041.	2957	San Joaquin	San Joaquin and Middle Rivers.	15.03	1,293	
Reclamation District No. 2042.	2958	San Joaquin	Bishop Canal and Disappointment Slough.	27.48	2,198	
Reclamation District No. 2044.	2959	San Joaquin	White and Disappointment Sloughs and Honker and Dredger Cuts.	40.75	3,260	
California Delta Farms, Incorporated.	2960	San Joaquin	Disappointment Slough.	10.70	858	
Wild Goose Country Club.	2963	Butte	Butte Creek.	22.50	1,797	2,000
Jerome D. and John J. Kuok.	2973	Siskiyou	Parks Camp Canal.	5.00	680	6,000
Oroville-Wyandotte Irrigation District.	2978	Yuba	Dry Creek.	150.00	210.00	299,016
J. W. Preston, Jr.	2979	Butte	Lost Creek.	225.00		
Oroville-Wyandotte Irrigation District.	2997	Amador	North Fork Mokelumne River.	2,000.00	2,400,000	400,000
Henry Werth.	3004	Placer, Eldorado	American River.	2,000.00	1,000,000	5,000,000
W. H. Samson.	3008	Trinity	Trinity River.	2,000.00	1,000,000	5,000,000
W. H. Samson.	3009	Trinity	Trinity River.	2,000.00	1,000,000	5,000,000
W. H. Samson.	3010	Trinity	Trinity River.	2,000.00	73,000	
W. H. Samson.	3011	Trinity	Trinity River.	500.00		
A. J. Cleary.	3014	Sacramento, Eldorado	South Fork American River.	357.00	28,107	581,122
353 smaller projects						



TABLE NO. 21.

**Important Proposed Hydro-Electric Power Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 500 theoretical horsepower or more are listed by name. Projects of less than 500 theoretical horsepower are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Applica- tion number	County	Source of supply	Amount of water		Theoretical power to be developed	Estimate cost
				Natural flow, second-feet	Storage, acre-feet		
R. E. Swigart (Klamath-Shasta Valley Irrigation District)	1996	Siskiyou	Shasta River	750.00	---	25,500	---
Southern Sierras Power Company	1997	San Bernardino	Alder, Lost, Vivian, Willow and High Creeks	20.00	---	4,634	\$500,000
San Diego Consolidated Gas and Electric Company	1998	San Diego	Paco and Lion Creeks	10.00	12,000	680	110,000
San Diego Consolidated Gas and Electric Company	1999	San Diego	West Fork San Luis Rey River	15.00	12,000	775	235,000
E. Fletcher	2000	San Diego	Boulder Creek	50.00	---	9,222	390,000
San Joaquin Light and Power Corporation	2002	Fresno	North Fork Kings River and Woodchuck, Post Corral, Bandoria and Statum Creeks	200.00	40,000	13,580	---
San Joaquin Light and Power Corporation	2023	Fresno	Burnt Corral, Post Corral and Fleming Creeks	80.00	14,500	14,265	---
San Joaquin Light and Power Corporation	2024	Fresno	Holms Creek	175.00	41,000	23,793	---
San Joaquin Light and Power Corporation	2025	Fresno	Bench Valley Creek, Meadow Brook and North Fork Kings River	140.00	13,000	28,530	---
San Joaquin Light and Power Corporation	2030	Kern	Kern River	300.00	---	16,874	1,000,000
City of Los Angeles	2038	Fresno	South Fork Kings River	120.00	34,600	24,989	3,094,475
M. C. Seagrave	2051	Eldorado	Steeley Creek	25.00	5,500	2,273	275,000
M. C. Seagrave	2052	Eldorado	North Fork Cosumnes River	75.00	2,000	12,784	300,000
Southern Sierras Power Company	2064	San Bernardino	Falls Creek	12.50	---	2,908	620,307
R. E. Swigart (Klamath-Shasta Valley Irrigation District)	2075	Klamath, Ore.	Klamath River	---	1,600,000	110,000	5,000
Southern Sierras Power Company	2076	San Bernardino	High Creek	5.00	---	1,163	160,000
Southern Sierras Power Company	2077	San Bernardino	Falls Creek	60.00	99.70	4,655	12,348
Southern Sierras Power Company	2079	Riverside	Falls and Snow Creeks and East Fork of Snow Creek	75.00	---	11,402	600,000
Southern Sierras Power Company	2088	San Bernardino	Whitewater River	75.00	---	8,067	500,000
Southern Sierras Power Company	2089	Riverside	Whitewater River	60.00	---	5,577	253,956
Southern Sierras Power Company	2090	Riverside	Snow Creek and tributaries	100.00	---	24,000	2,000,000
G. M. T. Crocker and J. W. Preston	2095	Alpine	West Fork Carson River	400.00	40,000	55,000	---
W. W. Hawley	2100	Alpine	North Fork Mokelumne River	300.00	60,000	20,000	200,000
O. Scribner	2101	Eldorado	Sugar Pine, Davis and Onion Creeks	300.00	4,000	9,955	---
O. Scribner	2110	Eldorado	Middle Fork Cosumnes River	130.00	83,950	12,520	---
O. Scribner	2111	Eldorado	North Fork Cosumnes River	30.00	20,000	2,000	---
O. Scribner	2112	Eldorado	North Fork Cosumnes River	17,340	17,340	7,437	---
O. Scribner	2113	Eldorado	North Fork Cosumnes River, Camp and Clear Creeks	196.00	81,500	13,870	---
O. Scribner	2114	Eldorado	North Fork Cosumnes River and Camp Creek	60.00	59,980	10,555	---
O. Scribner	2115	Eldorado	Camp and Sly Park Creeks	40.00	28,900	3,768	---
O. Scribner	2117	Eldorado	South Fork Cosumnes River	60.00	43,360	6,126	---
O. Scribner	2118	Amador	South Fork Cosumnes River	14.00	10,200	12,934	---
O. Scribner	2119	Eldorado	Middle Fork Cosumnes River and Sopiago Creek	100.00	54,200	5,673	---

O. Seribner	2120	Amador	Dry Creek	20.00	8,223	12,865,000
O. Seribner	2122	Amador	South and Dry Creeks	125.00	7,800	153,849
R. H. Elliott	2124	Sierra	Middle Yuba River	80.00		3,500
Excelsior Water and Power Company	2126	Nevada	Deer Creek	100.00	40,000	930,000
Excelsior Water and Power Company	2128	Nevada	Deer Creek	200.00	10,000	2,750,000
City of Los Angeles	2148	Inyo	Pine and Morgan Creeks	60.00	5,558	15,710
J. H. Hughes	2148	Inyo	French River	28.00	2,863	150,000
O. Seribner	2162	Butte	Cosumnes River	100,000	25,500	6,000
R. E. Fairchild	2164	San Bernardino	Bear Creek	50.00	2,300	37,000
R. E. Fairchild	2165	San Bernardino	Santa Ana River and Forsee Creek	50.00		150,000
R. E. Swigart, trustee for Irrigation District	2168	Klamath, Ore.	Klamath River	28,920	2,300	60,000
Wood Estate Company	2171	Plumas	South Fork Feather River	3,000.00	30,000	2,000,000
D. Moulton	2175	Siakiyou	Klamath River	5,000.00	145,000	8,000,000
Electro Metals Company	2187	Humboldt	Klamath River			59,810
G. F. Taylor et al.	2195	Plumas, Sierra	Middle Fork Feather River, Onion, Bear and Bucks Creeks, Grizzly Valley and Gold Lake	550.00	19,886	1,730,000
R. H. Elliott	2197	Yuba	North Yuba River	700.00	28,977	1,500,000
R. H. Elliott	2198	Sierra	North Yuba River	400.00	105,906	7,250,000
R. H. Elliott	2199	Sierra	North Yuba River	590.00		1,315,000
R. H. Elliott	2200	Sierra, Nevada	North Fork Yuba River, Middle and East Forks of North Fork Yuba River and Hog Canon	165.00	124,872	3,000
Excelsior Water and Power Company	2203	Nevada	Poorman Creek	40.00	10,031	6,500,000
Excelsior Water and Power Company	2205	Nevada	Caanyon Creek	240.00	75,234	1,927,000
Excelsior Water and Power Company	2207	Nevada	South Yuba River	350.00	20,862	2,443
Little Rock Power and Water Company	2213	Los Angeles	Little Rock Creek	50.00	4,507	1,600,000
R. E. Fairchild	2238	San Bernardino	Santa Ana River and Bear Creek	90.00	110,000	5,972
Excelsior Water and Power Company	2244	Sierra, Nevada	Middle Fork Yuba River	140.00	15,000	6,800
W. Neumann	2245	San Benito, Fresno	San Benito River and Big Panoche Creek	500.00	24,374	2,556,000
Excelsior Water and Power Company	2248	Nevada	Canyon Creek	240.00	23,247	5,273,109
Excelsior Water and Power Company	2249	Nevada	Deer Creek and Excelsior Ditch	410.00	150,000	3,250
Excelsior Water and Power Company	2250	Nevada	Poorman Creek	40.00	150,000	2,073,000
Excelsior Water and Power Company	2251	Nevada	Deer Creek and Excelsior Ditch	410.00	28,180	1,500,000
R. C. Hackley	2252	Butte	Middle Fork Feather River	705.00	23,984	5,000,000
R. C. Hackley	2254	Plumas, Butte	Branch of Middle Fk. Feather River, Fall River, South Middle and South Fks. Feather River, and Little North Fk. Feather River and Arkansas Ravine	685.00	104,419	4,500,000
R. C. Hackley	2255	Butte	Middle Fork Feather River	705.00	73,391	2,000,000
G. M. Trent	2258	Alpine	West Fork Carson River	100.00	24,000	2,000,000
J. E. Taylor et al., for Nevada Irrigation District	2272	Sierra	South Fork of Middle Fork Yuba River	50.00		25,000
J. E. Taylor et al., for Nevada Irrigation District	2274	Sierra	South Fork of North Fork Yuba River	25.00		2,500
J. M. Howells	2275	Nevada	Middle Fork Yuba River	75.000		306,000
Little Rock Power and Water Company	2292	Tehama	Deer Creek and Mill Creek	300.00	20,000	600,000
L. O. Griffith	2297	Los Angeles	Little Rock Creek	50.00	2,040	3,000,000
R. H. Elliott	2301	Butte	Middle and South Fork Feather River	400.00	48,863	15,450
R. O. Mills	2306	Placer	South Fork Yuba River	250.00	24.000	36,000
J. C. Mills	2337	Yuba	Rock and Slate Creeks	80.00	20,000	760,000
Lake Hemet Water Company	2340	Riverside	Strawberry and South Fork Creeks	20.00		3,600
E. H. Libby	2343	Los Angeles	Big Rock Creek			

TABLE NO. 21—Continued.

**Important Proposed Hydro-Electric Power Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 500 theoretical horsepower or more are listed by name. Projects of less than 500 theoretical horsepower are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Appli- cation number	County	Source of supply	Amount of water		Theoret- ical horse- power to be developed	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
V. S. Barber.....	2345	Plumas.....	Rock and Chambers Creeks and seven lakes at headwaters thereof. North Valley Creek and unnamed creek in Crane Valley. Campbell Lake and unnamed flat on North Valley Creek.	70.00	32,000	10,900	\$1,500,000
V. S. Barber.....	2347	Plumas.....	Nelson Creek and East Branch Nelson Creek.	100.00	---	12,500	400,000
San Joaquin Light and Power Corporation.....	2363	Fresno.....	Roaring River.	270.00	25,700	56,763	10,000,000
San Joaquin Light and Power Corporation.....	2364	Fresno.....	Bubbs Creek.	170.00	21,000	46,170	9,600,000
San Joaquin Light and Power Corporation.....	2365	Fresno.....	Kings River.	1,900.00	1,000	64,772	6,500,000
Great Western Power Company.....	2369	Plumas.....	Bucks Creek.	124.00	70,000	43,000	4,300,000
Great Western Power Company.....	2370	Plumas, Butte.....	Pine, Rock, North Valley, Little Kinsheiw and Crane Valley Creeks.	374.00	100,000	48,000	---
F. H. Tibbetts.....	2372	Nevada.....	Canyon and Fall Creeks.	300.00	100,000	---	---
V. S. Barber.....	2385	Plumas.....	Milk Ranch Creek.	60.00	2,800	27,273	---
V. S. Barber.....	2386	Plumas.....	Chippis Creek, Morris, Lots, Spring Valley and four unnamed lakes.	100.00	9,800	34,090	1,600,000
Seape Power Corporation.....	2402	Ventura.....	Sespe Creek.	135.00	102,000	---	---
Coachella Valley County Water District.....	2419	San Bernardino.....	Whitewater River.	10.00	---	2,500	125,000
Coachella Valley County Water District.....	2420	San Bernardino.....	Whitewater River.	20.00	---	1,800	100,000
Coachella Valley County Water District.....	2421	San Bernardino.....	Whitewater River.	30.00	---	3,070	160,000
Coachella Valley County Water District.....	2422	Riverside.....	Whitewater River.	50.00	---	4,550	273,000
Coachella Valley County Water District.....	2423	Riverside.....	Whitewater River.	70.00	---	4,780	288,800
Coachella Valley County Water District.....	2424	Riverside.....	Whitewater River.	90.00	---	4,100	200,000
Coachella Valley County Water District.....	2425	Riverside.....	Middle and West Forks Snow Creeks.	60.00	---	5,700	250,000
Coachella Valley County Water District.....	2426	Riverside.....	Middle and West Forks Snow Creeks.	70.09	---	7,160	---
Gay Wilkinson.....	2435	Butte.....	Feather River.	15,000.00	---	58,646	---
Caldwell and South San Joaquin Irrigation District.....	2460	Voluntine.....	San Joaquin River.	2,000.00	150,000	54,000	1,500,000
City of Sacramento.....	2467	Eldorado.....	South Fork Silver Creek.	150.00	32,000	11,300	---
City of Sacramento.....	2468	Eldorado.....	Silver, Onion and Davis Creeks, North and South Forks of Silver Creek and Sugar Pine Creek.	475.00	90,000	110,000	---
City of Sacramento.....	2470	Eldorado.....	Silver Creek and North and Davis Creeks.	---	90,000	18,700	---
City of Sacramento.....	2479	Eldorado.....	Sugar Pine, Onion and Davis Creeks.	200.00	45,000	54,000	---
City of Sacramento.....	2480	Eldorado.....	North and South Forks Rubicon River and Gerle Creek.	150.00	5,000	---	---
City of Sacramento.....	2481	Eldorado.....	Rubicon River.	70.00	42,000	---	---
City of Sacramento.....	2482	Eldorado.....	Gerle Creek.	70.00	---	---	---
R. C. Hackley.....	2488	Butte.....	Middle Fork Feather River.	530.00	100,000	80,000	5,000,000



2492	Ambrose Madden	Sierra	Kanaka Creek	20.00	7.000	124,872	750,000
2493	Roy H. Elliott	Nevada, Sierra	Middle Fork Yuba River and three unnamed creeks	20.00	51,000	68,700	6,000,000
2500	Mokelumne River Power Company	Amador	Mokelumne River	500.00		34,090	1,044,000
2509	C. F. Dunsenberg	Eldorado	South Fork American River	1,000.00		4,375	1,500,000
2510	W. H. Samson	Trinity	Stuarts Fork and Deer Creek	50.00	31,300	3,976	30,000
2515	W. H. Samson	Trinity	Van Mater Creek	50.00		3,976	100,000
2516	W. H. Samson	Trinity	Owens Creek	50.00	31,300		500,000
2517	W. H. Samson	Trinity	Stuarts Fork			9,090	20,000
2518	W. H. Samson	Trinity	Deep Creek	50.00		383,600	21,860,000
2522	Southern California Edison Company	Fresno	San Joaquin River	3,000.00		17,613	556,000
2528	Excelsior Water and Power Company	Nevada	Deer Creek	625.00		35,438	2,689,000
2529	Excelsior Water and Power Company	Nevada	Deer Creek	625.00		18,154	
2533	C. L. Walker	Shasta	Pit River	1,600.00		19,050	
2535	J. W. Preston, Jr.	Amador	North Fork Mokelumne River	275.00	300,000		
2536	J. W. Preston, Jr.	Amador	Sutter Creek	275.00		18,400	
2548	Beckman Linden Engineering Corporation	Amador	Cold Creek, Beaver Creek, Bear River	400.00		55,000	
2555	Bear River Water and Power Company	Calaveras, Amador	Calaveras and Mokelumne Rivers	250.00	100,000	8,530	1,000,000
2562	Bear River Water and Power Company	Calaveras	Canyon Creek	10,000	10,000	65,000	250,000
2563	San Joaquin Light and Power Corporation	Nevada, Placer	Bear River, South Wolf, Wolf, Dry and Little Wolf Creeks	1,686.00	25,500	95,454	1,500,000
2585	San Joaquin Light and Power Corporation	Mariposa	South Fork Merced River	800.00	90,000		
2586	San Joaquin Light and Power Corporation	Mariposa	South Fork Merced River	800.00		145,454	
2587	San Joaquin Light and Power Corporation	Mariposa	South Fork Merced River	800.00		22,727	
2588	San Joaquin Light and Power Corporation	Mariposa	South Fork Merced River	800.00		12,182	
2608	F. B. Tuttle, Jr.	Placer	Rubicon River and Middle Fork American River	600.00	200,000	136,000	3,300,000
2610	M. C. Seagrave	Eldorado	North Fork Cosumnes River	75.00	18,003	12,784	300,000
2611	F. B. Tuttle, Jr.	Placer	Rubicon River, Middle and North Forks American River	800.00	200,000	54,000	5,000,000
2612	F. B. Tuttle, Jr.	Placer	Rubicon River, Middle and North Forks American River	800.00	200,000	68,000	4,300,000
2616	Excelsior Water and Power Company	Nevada	Canyon Creek	60.00	35,000	1,991	760,000
2643	Wendota Irrigation District	Trinity	Stuarts Fork of Trinity River	125.00		3,663	500,000
2674	W. H. Kendall	Fresno	Kings River	2,000.00		13,300	1,200,000
2680	W. H. Samson	Tuolumne	North Fork Tuolumne River	35.00		10,227	50,000
2702	W. P. Tuttle, Jr.	Trinity	Rush Creek	100.00		200,000	650,000
2720	W. P. Tuttle, Jr.	Placer	North Fork American River	600.00		500,000	
2725	W. M. Matthews	Placer	North Fork American River	75.00	400,000		
2730	B. M. Cowan, trustee	Kern	Kern River	1,000.00	1,000,000		
2740	H. L. Perkey	Sierra, Plumas	Slate Creek			500,000	2,500,000
2749	Pacific Gas and Electric Company	Butte	Clear Creek		3,740	38,700	753,000
2750	Pacific Gas and Electric Company	Nevada	Pondre Creek		26,671	17,031	747,500
2751	Pacific Gas and Electric Company	Alpine	Deer Creek		15,043	15,043	37,500
2752	Pacific Gas and Electric Company	Butte	West Branch of North Fork Feather River		3,700	3,563	182,000
2753	Pacific Gas and Electric Company	Nevada, Placer	North Fork Feather River			8,675	
2754	Pacific Gas and Electric Company	Butte	Bear River	100.00		2,716	25,400
2755	Pacific Gas and Electric Company	Tehama	Philbrook Creek	50.00	5,060	4,781	134,400
2767	R. H. Elliott	Sierra	Middle Fork Yuba River, Milton Creek, unnamed branch of Milton Creek, South Fk. of South Fk. of North Yuba River, Saddle Creek, unnamed branch, South Fk. of South Fork of North Yuba River, North Fk. of South Fk. of North Yuba River			148,056	2,700,000
2773	I. H. Parker	Placer	Bear River	400.00		13,636	
2776	R. H. Elliott	Yuba, Sierra	Slate, Canyon, Cherokee Creeks, Boyce Ravine and North Yuba River	200.00	60,000		900,000
2780	W. L. Leland	Siskiyou	Inconstance Creek, Brewer and Ash Creeks	280.00	105,906		



TABLE NO. 22.

**Important Proposed Mining Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 10 second-foot or more are listed by name. Projects of less than 10 second-feet are shown as single group at the end of the table. Cancelled applications are not included.

Name of applicant	Applica- tion number	County	Source of supply	Amount of water		Estimated cost
				Natural flow, second-foot	Storage, acre-feet	
J. C. Mills and H. L. Berkey	2003	Sierra	Canyon Creek	60.00	8,212	\$100,000
G. W. Glass and T. C. Peterson	2074	Siskiyou	Monte Creek	12.00		6,000
E. W. Gundlach	2415	Trinity	Forse Creek	25.00		500
H. P. Riley	2436	Mono	Miner Creek	15.00		5,000
S. J. Jaquemart	2444	Siskiyou	Little North Fork Salmon River	100.00		4,000
S. P. Clyburn	2494	Siskiyou	Deer Creek	22.50		12,000
M. T. Pratt	2534	Plumas	South Fork Feather River	150.00		600,000
R. H. Elliott	2601	Placer, Nevada	South Fork Yuba River		26,130	20,000
F. M. Wilson	2644	Humboldt	Camp and Wilder Creeks	75.00		250,000
Humboldt Placer Mining Company	2663	Trinity	Stuarts Fork Trinity River	75.00		7,000
Humboldt Placer Mining Company	2665	Trinity	Owens Creek	25.00		5,600
Humboldt Placer Mining Company	2667	Trinity	Van Matre Creek	25.00		200
Humboldt Placer Mining Company	2673	Trinity	Slate Creek	25.00		10,000
William Forstner	2682	Siskiyou	Fore Creek	30.00		500
William Forstner	2682	Siskiyou	Fore Creek	10.00		10,000
H. G. Salomon	2708	Trinity	East Fork of North Fork Trinity River	50.00		30,000
T. M. Gibson	2719	Trinity	Canyon Creek	50.00		40,000
F. H. Oquid	2763	Del Norte	West Fork of East Fork Illinois River	125.00		50,000
R. H. Elliott	2820	Nevada	Jordan Creek	125.00		800
A. E. Flanagan	2823	Sierra	Nigger Ravine	11.00		125,000
J. C. Mills	2834	Sierra	Cason Creek	60.00	9,500	2,500
E. Pruess	2858	Del Norte, Josephine, Ore	West Fork of Athouse Creek and Frog Gulch	40.00		75,000
J. Neffrey	2912	Siskiyou	Woolley Creek	75.00		2,500
F. L. Kendall	2927	Trinity	East Fork of Stuarts Fork and Strope Creek	43.00		6,000
Frank M. Wilson	2972	Siskiyou	Buzzard Creek	20.00		7,500
J. L. Coyle	2984	Trinity	Holland Lake on East Fork of Coffee Creek	20.00		2,500
R. H. Elliott	2986	Nevada	Diamond Creek	80.00		2,500
F. L. Kendall	2988	Trinity	East Fork of Stuarts Fork	19.50		227,625
<b>39 smaller projects</b>				<b>75.32</b>	<b>480</b>	



**TABLE NO. 23.**  
**Proposed Municipal Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1922.**

NOTE.—Cancelled applications not included.

Name of applicant	Applica- tion number	County	Source of supply	Amount of water		Popula- tion	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
City of Los Angeles.....	2020	Inyo	Owens River.....	50.00	---	575,000	\$15,000
Escondido Mutual Water Company.....	2021	San Diego.....	San Luis Rey River.....	60.00	20,000	2,000	575,500
E. H. Wilcox.....	2060	Los Angeles.....	West Fork San Gabriel River.....	---	50,000	70,000	---
City of Los Angeles.....	2094	Inyo.....	Hogback Creek.....	10.00	---	575,000	5,500
City of Pasadena Water Department.....	2154	San Bernardino.....	Mojave River.....	---	80,000	50,000	---
Geary Rich.....	2214	Solano.....	Lindsay Slough.....	10.00	356	25,600	2,000,000
A. A. Peters for City of Petaluma.....	2351	Sonoma.....	Crane, Copeland, Lichau, Haggin, Lynch, Adobe Creeks.....	320.00	---	---	---
Mountain Power Company.....	2459	Del Norte.....	Unnamed creek.....	.50	90,000	1,500	10,000
City of Sacramento.....	2469	Eldorado.....	Silver Creek and North and South Fks. of Silver Creek.....	1.50	1,100	70,000	53,000
Town of Antioch.....	2713	Contra Costa.....	San Creek and unnamed creek.....	500.00	---	9,571	---
East Lugonia Mutual Water Company and City of Redlands.....	2791	San Bernardino.....	Mill Creek.....	250.00	65,000	400,000	10,000,000
Snow Mountain Water and Power Company.....	2861	Mendocino.....	Middle Del River, Thatcher and Elk Creeks.....	---	6,100	7,500	---
City of San Luis Obispo.....	2916	San Luis Obispo.....	Lopez Creek.....	---	4,000	---	---
City of San Luis Obispo.....	2917	San Luis Obispo.....	Arroyo Grande Creek.....	4.00	44,225	100,000	1,250,000
Ed. Fletcher, Jr.....	2989	San Diego.....	San Diego River.....	---	75.00	---	---
City of San Diego.....	2992	San Diego.....	Flume Nine Creek.....	---	1,200	90,000	1,300,000
City of San Diego.....	2993	San Diego.....	Rattlesnake Creek.....	75.00	2,000	---	---
City of San Diego.....	2994	San Diego.....	Tunnel Two Creek.....	75.00	---	---	---
City of San Diego.....	2995	San Diego.....	Matchin Creek.....	75.00	2,000	---	---

**TABLE NO. 24.**  
**Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits issued for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Appli- cation number	County	Source of supply	Acres irrigated	Second-foot granted	Acres-foot granted	Estimated cost
E. R. Dimond	756	1802	San Mateo	East Branch Dennis Martin Creek	150		30	\$23,250
F. W. Hooper	757	1749	Mendocino	Flood waters	120		5	1,000
G. C. Keough	760	117	Inyo	Ham Canyon	150			1,200
I. C. Beverly	762	1474	Modoc	Fletcher Creek	315	25	675	1,200
A. O. Hays	764	1801	Stanislaus	Orestimba Creek	225	2.81		800
G. R. Hicks	768	650	San Bernardino	Upper Little Morongo Creek	200	2.50		2,000
A. Murray	769	1533	Inyo	Spring	100	1.00		1,200
C. S. Powell	773	1504	Lassen	Wire Lake	235		390	1,000
E. A. Stephens	774	1505	Lassen	Cottonwood Lake	235		135	400
L. Bly (Trustee for Irrigation District)	776	1239	San Bernardino	Mojave River	180	2.25		
L. Bly (Trustee for Irrigation District)	782	1209	Lassen	Eagle Lake	12,500		30,000	1,000,000
Paul and Philip Bancroft	783	203	Lassen	Eagle Lake	12,500		30,000	1,000,000
T. F. Masterson Estate	784	1633	Stanislaus	Tulomne River	498	6.22		10,000
Conaway Ranch	786	1492	Yolo	East Fork Scott River	100	1.25		2,000
J. H. Jones	787	1588	Butte	Sacramento River	16,194	200.00		600,000
Williams Irrigation District	789	1656	Butte	Hamlin Slough	2,768	12.00		
Williams Irrigation District	797	1354	Colusa	Trough Colusa Basin	6,661	83.27		350,000
Williams Irrigation District	798	1624	Colusa	Trough Colusa Basin	2,561	32.01		425,000
Crooks Canyon Irrigation District	799	1635	Colusa	Trough Colusa Basin	440	5.50		425,000
M. C. Smith	803	1637	Modoc	Drainage Area	4,383		9,177	77,830
W. F. Beal et al.	804	1638	Inyo	Waste Water Kaiser Ravine	320	3.00		350
J. M. England	805	1525	San Diego	Coyote Creek	640	8.00		10,000
Weyerhaeuser Realty Company	813	1485	Modoc	French Creek	160		275	5,000
F. Edgar	816	1985	Modoc	Klamath River	133	1.67		5,730
C. B. DeMille	819	1778	Placer	Unnamed creek	120	1.50		200
C. D. Peterson	822	1884	Los Angeles	Unnamed creek and unnamed canyon	130	0.30		
C. G. Bonner	827	1873	Modoc	Sacramento Canyon	240	2.00		8,000
W. Michaelson	830	1884	Yolo	Bear Creek	273	2.00		10,000
Meek Estate	842	2010	Yuba	Burns Creek	199	2.00		10,000
S. S. Hawley (Manager Meek estate)	845	1952	Yolo	Unamed springs and creek	130	1.62		300
D. A. Middlecamp	846	1753	Yolo	Sycamore Slough	2,022	25.27		90,000
Avenado and Capurro	847	1422	Glen	Sacramento River	2,022	25.27		60,000
W. J. Dorris	849	1880	Modoc	Willow Creek	404	5.05		6,000
W. J. Dorris et al.	852	760	Modoc	Pine Creek	800		400	1,000
W. J. Dorris et al.	853	1042	Modoc	Pine Creek and Stockkill Slough	3,522		2,709	5,000
W. J. Dorris et al.	854	1321	Modoc	Park Creek	555		1,191	12,000
C. E. Smith	855	2008	Riverside	Palo Verde Lagoon	223		6,100	15,000
					156	1.95		2,000

TABLE NO. 24—Continued.

**Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1922.**

Nor.—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits issued for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled things are not included.

Name of permittee	Permit number	Appli- cation number	County	Source of supply	Acres irrigated	Second-foot granted	Acre-foot granted	Estimated cost
Phebe J. Henshaw	856	2043	San Bernardino	Davis Springs (2)	160	30		\$2,000
T. G. Berryhill, Jr.	861	1667	Stanislaus	Tuolumne River	353	4.41		3,000
J. M. Grove et al.	862	2019	Siskiyou	Jenny Creek	501	5.25		2,000
A. W. Witt	863	1730	Merced	Merced River	208	6.92		2,000
W. F. Vance	868	1545	Tehama	Mooney Slough	554	6.92		10,000
A. T. Thompson	869	1742	San Bernardino	Spring (2) Arctic Canyon	320	5.0		5,000
O. T. Thompson	871	1788	Merced	Merced River	320	4.00		6,000
N. M. Roberts	872	2093	Modoc	Antelope Flat Drainage Area	501	7.47	2,635	4,000
A. Quader	882	1592	Butte	Sacramento River	598	160.00		9,000
Holland Land Company and I. B. Parsons	884	1666	Yolo	Antelope Plains Drainage Area	18,000		1,550	75,000
Mary E. Ivory	885	421	Modoc	Merced River	675	1.34		2,400
R. A. Moncre	889	1906	Merced	Merced River	107	1.75		4,500
G. H. and M. S. Winton	890	1322	Mono	Sardine Lake	140			1,200
A. Farrington et al.	891	1754	Modoc	Merced River	1,760		765	3,000
J. J. Stevenson	893	1885	Modoc	Willow Creek	6,446	80.58		75,000
H. Drew et al.	897	1399	Shasta	Fall River	170	2.10		700
Fall River Valley Irrigation District	898	1874	Shasta	Fall River	15,680	186.00		240,000
Fall River Valley Irrigation District	899	1467	Kern	Spring	4,320	54.00		60,000
H. C. Heaton	901	2132	Siskiyou	Dobkins Lake	160	.06		3,500
S. Hammond	902	1981	San Diego	Escondido Creek	940	8.00	960	500
San Dieguito Mutual Water Company	905	2188	Mendocino	Russian River	3,600	1.44	12,011	250,000
Lulu H. Holtze	911	1983	Humboldt	Mad River	115			6,000
Merced Irrigation District	914	1224	Inyo	Nine Mile Creek	189,781	1,500.00	300,000	12,000,000
W. W. Turner	921	2044	Inyo	Spring	140	1.75		2,000
D. W. Sterling	924	1406	Butte	Unnamed spring	160	1.00		300
W. L. Wells	928	2176	Butte	Drainage Ditch—Drainage District 100	160	1.00		500
J. M. Reynolds	930	2233	Merced	Merced River	277	3.47		1,000
J. W. Ehmman	931	2283	Merced	Merced River	129	1.61		2,000
State Dept. of Public Works, Division of Land Settlement	940	1442	Riverside	Santa Ana River	459	2.00		5,500
W. J. Hole	941	1957	Riverside	Santa Ana River	459	2.00		20,000
W. J. Hole	942	1958	Riverside	Santa Ana River	440	2.00		15,000
W. J. Hole	943	2224	Riverside	Santa Ana River	459	0.50		20,000
W. J. Hole	944	2225	Riverside	Santa Ana River	440	0.50		15,000
E. Chamberlain	948	2134	Imperial	Alamo River	160	2.00		2,000
W. J. Rogers	955	2045	Los Angeles	Spring	100	0.15		3,500
G. W. Price	960	2072	Tuolumne	Dry Creek	263	3.31		2,000
J. P. Vmet	964	2086	San Joaquin	Lone Tree Creek	533	6.67		5,000



D. B. Kane et al.	971	1117	Modoc	Howard Gulch Drainage Area	487	1,200		8,000
						1.75	500	
R. Hainsworth	972	2048	Alpine	West Fork Carson River	140	1.87	1,500	500
R. Hainsworth	973	2326	Alpine	West Fork Carson River	150	3.94	1,000	1,500
F. B. Hays, Jr.	974	2362	Alpine	West Fork Carson River	315	2.00	1,500	1,500
J. C. Hattak	986	1975	Mono	Underground flow	160	0.01	150	150
J. H. Holt	988	2524	Los Angeles	Unnamed spring	147	1.84	4,000	150
A. T. Gibson et al.	1001	2330	Los Angeles	Pine Creek	120	1.50	3,000	3,000
R. M. Pike	1005	1051	Butte	San Joaquin River	3,739	46.74	125,000	4,000
W. B. Mason	1011	1476	Shasta	Indian Canyon	320	2.00		
J. H. Bunn	1017	2491	Shasta	Montgomery Creek	200	2.50		
Ann L. Anderson	1031	2097	Trinity	Mad River	140	1.75	600	600
P. T. Williamson	1051	2097	San Joaquin	San Joaquin River	536	6.70	3,000	3,000
S. Williamson et al.	1052	2091	San Joaquin	Stanislaus River	117	1.47	2,000	2,000
N. Lagler	1097	2939	San Joaquin	San Joaquin River	140	1.75	5,000	5,000
G. A. Clough	1098	1823	Telamona	Mill Creek	1,280	16.00	2,000	2,000
J. D. Gracyles	1099	1823	Sacramento	Cosumnes River	160	2.00	30,000	30,000
C. F. Quinn	1099	1823	Yuba	Dry Lake	120	1.50	500	500
Beumont Irrigation District	1097	1937	Riverside	Edgar and Noble Canyons	3,161	8.00	55,000	55,000
J. C. Knowles	1040	2361	Napa	Trout Creek	1,499		2,000	2,000
J. C. Knowles	1041	2361	Napa	Horseshoe Creek	160	2.00	1,000	1,000
W. D. McPherson	1047	2268	Napa	Rancheria Creek	280	3.00	80,000	80,000
V. R. McPherson	1048	2268	Mono	Bridgeport Canyon Creek	320	3.00	1,000	1,000
E. O. LaMontagne et al.	1049	2578	Mono	Cottonwood Canyon Creek	12,575		4,000	120,000
H. M. McDonald	1053	1692	Eldorado	Webber Creek	122			
H. M. McDonald	1069	2719	Santa Clara	Dry Creek	150	1.52		
W. B. Mason	1072	2719	Mono	Cottonwood Creek	160	2.00		
J. McCormack	1078	2625	Shasta	Dry Creek Slough	160	2.00	200	500
P. P. Glezen	1085	2185	Sacramento	Gleason Creek	120	1.50	2,900	2,900
G. M. La Nica	1081	2547	Kern	Long Tree Creek	160	2.00	250	250
W. J. Hole	1094	2096	San Joaquin	Drainage Area	400	2.00	2,000	2,000
C. Puchen et al. (Irrigation District)	1097	1470	Fresno	Fresno Slough	70,291	400.00		
South San Joaquin Irrigation District	1098	1446	Stanislaus	Stanislaus River	28,570	158.80		
G. A. Smith	1099	1241	Kings	Kings River	1,274	18.68	18,720	75,000
Sutter Mutual Water Company	1101	1756	Sutter	Sacramento River	268	3.35		
Sutter Mutual Water Company	1102	1757	Sutter	Sacramento River	193	2.40		
Sutter Mutual Water Company	1103	1758	Sutter	Sacramento River	160	2.00		
Sutter Mutual Water Company	1104	1759	Sutter	Sacramento River	160	2.00		
Sutter Mutual Water Company	1105	1760	Sutter	Sacramento River	191	2.40		
Sutter Mutual Water Company	1107	1762	Sutter	Sacramento River	120	14.00		
Sutter Mutual Water Company	1108	1763	Sutter	Sacramento River	480	6.00		
Sutter Mutual Water Company	1110	1764	Sutter	Sacramento River	160	2.00		
Sutter Mutual Water Company	1111	1765	Sutter	Sacramento River	480	2.00		
Sutter Mutual Water Company	1112	1767	Sutter	Sacramento River	440	5.50		
Sutter Mutual Water Company	1113	1768	Sutter	Sacramento River	200	2.50		
Butte Valley Irrigation District	1114	2234	Sis-yiyou	Antelope and Butte Creeks	250	100.00	20,000	940,000
Butte Valley Irrigation District	1115	2236	Sis-yiyou	Bear Creek	31,627	100.00	5,000	
Butte Valley Irrigation District	1116	2531	Sis-yiyou	Butte Lake			10,000	
Butte Valley Irrigation District	1117	1769	Sutter	Sacramento River	800	10.00		
Sutter Mutual Water Company	1118	1770	Sutter	Sacramento River	250	3.13		

TABLE NO. 24—Concluded.

**Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1922.**

NOTE.—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits issued for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Application number	County	Source of supply	Acres irrigated	Second-feet granted	Acre-feet granted	Estimated cost
D. J. Filipponi.....	1122	2267	Santa Barbara	Spring	118	11	—	500
Nakomeg Company of California	1129	1413	Sutter	Sacramento River	10,004	120.00	—	300,000
Happy Valley Irrigation District	1130	1774	Shasta	North Fork Cottonwood Creek	18,110	75.00	—	185,000
T. O'Brien.....	1131	780	Kern	Cuddy Creek	883	10.34	400	3,500
Maude C. Moore.....	1135	1701	Butte	Sacramento River	700	2.00	—	3,000
Knightsen Irrigation District	1136	1718	Contra Costa	Rock and Italian Sloughs, March Creek	10,001	125.00	—	12,000
Mt. Diablo Country Club	1142	2827	Contra Costa	Green Valley Creek	116	—	120	16,000
L. L. Lichens et al.	1144	2226	Siskiyou	Beaver Creek	375	4.69	—	3,000
South San Joaquin Irrigation District	1147	2524	Calaveras	Stanislaus River	71,081	—	36,000	500,000
<b>158 smaller projects</b>					<b>3,420</b>	<b>47.97</b>	<b>1,150</b>	<b>144,370</b>

**TABLE NO.125.**  
**Permits Issued for Power Purposes During Biennial Period Ending September 1, 1922.**

Norz.—Cancelled filings not included.

Name of permittee	Permit number	Appli- cation number	County	Source of supply	Second- feet granted	Acre-feet granted	Theoretical horse- power to be developed	Estimated cost
F. B. Patton et al.	775	1157	Calaveras	West Fork Stanislaus River	130.00	31,933	13,650	\$2,000,000
Snow Mount Water and Power Company	781	1719	Calaveras	South Yel River	150.00	215,000	21,455	3,000,000
H. L. Shinn	785	1381	Teahama	Deer Creek			10,227	500,000
Southern California Edison Company	807	1341	Fresno	Mono Creek		146,000	202,000	
Southern California Edison Company	808	1342	Fresno	Bear Creek		81,000	112,000	38,530,000
Southern California Edison Company	809	1343	Fresno	South Fork San Joaquin River		229,000	315,000	
Southern California Edison Company	810	1344	Fresno	South Fork San Joaquin River		41,000	56,500	
Southern California Edison Company	811	1345	Fresno	Pitman Creek		50,000	69,000	
Southern California Edison Company	812	1346	Fresno	Stevenson Creek		62,000	24,800	
Southern Sierras Power Company	860	1997	San Bernardino	Alder, Lost, Vivian and High Creeks	20.00		4,634	500,000
San Joaquin Light and Power Corporation	894	751	Kern	Kern River	250.00		7,727	882,000
San Joaquin Light and Power Corporation	895	2030	Kern	Kern River	300.00		7,727	1,090,000
San Joaquin Light and Power Corporation	896	1979	Tuolumne	Eagle Creek	2.00		16,874	200
Merced Irrigation District	912	1221	Mariposa	Merced River	1,200.00		48,000	9,500,000
Merced Irrigation District	913	1222	Mariposa	Merced River	1,200.00	282,000	48,000	
Southern Sierras Power Company	915	2064	San Bernardino	Falls Creek	12.50		2,908	620,307
Southern Sierras Power Company	916	2076	San Bernardino	High Creek	5.00		1,160	5,000
Southern Sierras Power Company	917	2077	San Bernardino	Falls Creek		100	1,160	160,000
C. F. Williams	933	2017	Mono	Mammoth Mining Tunnel	1.00		4,655	8,275
Southern California Edison Company	979	2522	Fresno	San Joaquin River	3,000.00		363,600	21,860,000
San Joaquin Light and Power Corporation	980	722	Fresno	West and North Forks Kings River and Deer Creek	400.00		223,296	30,000,000
San Joaquin Light and Power Corporation	981	1916	Fresno	Deer Creek	50.00		8,327	1,200,000
San Joaquin Light and Power Corporation	982	1917	Fresno	Deer Creek	50.00		8,778	1,200,000
San Joaquin Light and Power Corporation	983	1919	Fresno	North Fork Kings River and Rancheria Creek	250.00		70,312	9,600,000
San Joaquin Light and Power Corporation	984	1920	Fresno	North and West Forks Kings River	300.00		85,227	11,600,000
San Joaquin Light and Power Corporation	985	1921	Fresno	North Fork Kings River	750.00		35,795	4,850,000
Western States Gas and Electric Company	993	1439	Eldorado	South Fork American River and tributaries	280.00		18,220	1,000,000
Western States Gas and Electric Company	994	1440	Eldorado	South Fork American River	280.00		61,282	2,500,000
Western States Gas and Electric Company	995	1441	Eldorado, Alpine, Amador	Medley, Echo, Twin and Silver Lakes, Alder and Plum Creeks		72,000	110,143	1,500,000
Southern Sierras Power Company	1008	2079	Riverside	Falls, Snow and East Fork Snow Creeks	60.00		12,348	402,345
Southern Sierras Power Company	1009	2090	Riverside	Snow Creek and tributaries	60.00		5,577	253,956
R. Phelan	1043	863	Sierra	Springs	.25		1,000	8
F. A. Gowing	1056	2511	Siskiyou	Eddy's Gulch	2.50		57	2,000
Butte Meadows Company	1057	1839	Butte	Bolt Creek	2.50		199	35,000
J. E. Starratt et al.	1058	2545	Placer	Shirital Canyon	2.00		80	1,200
G. A. Newhall	1062	2624	Eldorado	Lonely Gulch Creek	2.00		187	2,800
F. M. Wilson	1065	2645	Humboldt	Lamp and Wilder Creek	3.00		137	2,800
F. M. Wilson	1066	2675	Humboldt	Wildier Creek	3.00		102	2,800
Little Rock Power and Water Company	1083	2293	Los Angeles	Little Rock Creek	50.00	4,507	2,443	350,000
Ed. Fletcher	1084	2237	Los Angeles	Little Rock Creek	50.00	2,040	2,500	305,000
J. M. Hughes	1109	567	San Diego	Santa Ysabel and Black Canyon Creeks	20.00		3,020	350,000
J. M. Hughes	1149	2150	Butte	French Creek	28.00		2,863	150,000



TABLE NO. 26.  
Permits Issued for Mining Purposes During Biennial Period Ending September 1, 1922.

NOR.—Cancelled filings not included.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Estimated cost
C. W. Henry	761	1789	Kern	Poso Creek	10.00		\$500
American Magnesium Company	765	1690	San Bernardino	Underground water	1.00		100,000
A. F. Hammer	766	1709	Humboldt	Maddon Creek	50.00		5,000
L. Delera	790	1673	Plumas	South Fork Feather River	3.00		1,200
Beardsley Copper Company	825	1800	Plumas	Taylor Lake and Davis Creek			2,000
G. R. Lickow	844	1896	San Bernardino	Ivyen Spring			10,000
C. P. Fenton	855	1882	Trinity	New River	1.00	475	75,000
M. J. Beck Copper Company	864	1888	Inyo	Harrel Spring	125.00		5,000
H. I. Barta	884	1898	Siskiyou	West Fork Beaver Creek	50		20,000
J. Barnett et al.	926	2413	Siskiyou	Little Soda Creek	25.00		5,000
W. W. Myers	945	2192	Inyo	Thompson Canon Springs	3.00		1,400
D. B. Fields et al.	949	1460	Trinity	North Peaver Creek	05		
C. Badler et al.	958	2157	Yuba	Live Oak Gulch	3.00		1,500
M. Ward	975	2133	Yuba	Thompson Bridge Creek	1.25		25
A. Jaquemart	1007	2444	Siskiyou	Little North Fork Salmon River	2.00		2,000
Transport Oil Company	1022	2253	Kern	Unnamed stream	100.00		5,000
P. E. Rulon	1045	2590	Siskiyou	Beaver Creek	32		4,000
American Magnesium Company	1046	1836	Inyo	Goler Wash	3.00		1,000
G. W. Glass et al.	1050	2074	Siskiyou	Monte Creek	13		5,000
American Trona Corporation	1052	2523	Inyo	Springs	14		6,000
B. N. Russell	1060	2378	Inyo	Duck Creek	1.00		13,250
F. M. Wilson	1064	2644	Humboldt	Cann and Wilde Creeks	75.00		20,000
E. J. Curran	1067	2567	Siskiyou	Salmon River	3.00		2,000
R. D. Owen	1068	2229	Inyo	Elderberry Creek	1.50		500
Darwin Silver Company	1086	2359	Inyo	Darwin Wash	2.00		35,000
P. C. Thorne	1096	2467	Sierra	Lake Hawley	5.00		50,000
S. M. Campbell et al.	1126	2346	Trinity	Manzanita Creek	3.00	450	1,200

**TABLE NO. 27.**  
**Permits Issued for Municipal Purposes During Biennial Period Ending September 1, 1922.**

Name of permittee	Permit number	Appli- cation number	County	Source of supply	Second-feet granted	Acre-feet granted	Popula- tion	Estimated cost
Snow Mountain Water and Power Company	857	1934	Mendocino	South Eel River	400.00	215,000	500,000	\$10,000,000
Snow Mountain Water and Power Company	858	1720	Lake, Mendocino	South Eel River	225.00	10,000	80,000	1,800,000
City of Sacramento	992	1743	Sacramento	Sacramento River	7.00	10,000	21,107	800,000
City of Valjo	1042	1908	Napa	Gordon Valley Creek	.50		1,500	10,000
Mountain Power Company	1074	2459	Del Norte	Unnamed Creek				

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PART V

REPORT

OF THE

Division of Land Settlement

A SUBDIVISION OF THE

DEPARTMENT OF PUBLIC WORKS

OF THE

STATE OF CALIFORNIA

---

*To Accompany the First Biennial Report  
of that Department*

SEPTEMBER 1, 1922

ELWOOD MEAD, Chief of Division



CALIFORNIA STATE PRINTING OFFICE  
FRANK J. SMITH, Superintendent  
SACRAMENTO, 1923



STATE OF CALIFORNIA  
DEPARTMENT OF PUBLIC WORKS

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DIVISION OF LAND SETTLEMENT

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ELWOOD MEAD .....Chief of Division of Land Settlement  
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WALTER E. PACKARD.....Superintendent, Delhi Settlement  
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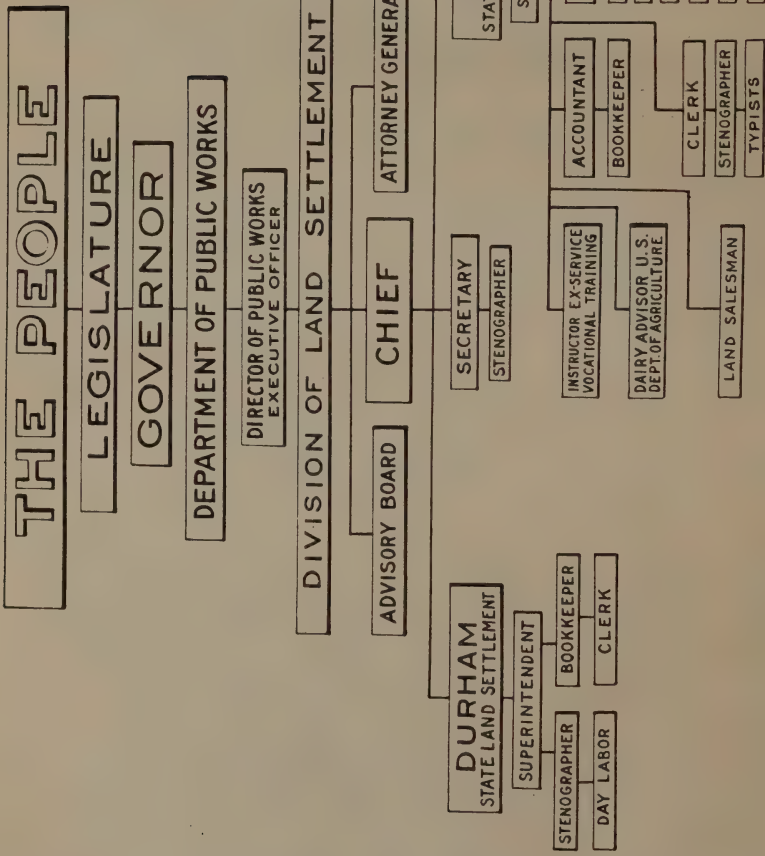
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# REPORT

## DIVISION OF LAND SETTLEMENT.

## DEPARTMENT OF PUBLIC WORKS.

ELWOOD MEAD, Chief of Division.

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It is the man who buys farm land today for whom the farm problem must be solved. If it is not solved for him, then the annual crop of those buying farms will fail and American agriculture will decay.—*World's Work*, September, 1922, p. 511.

During the past two years California has given repeated evidences that rural development is regarded as a matter of great importance. The efforts to add 300,000 acres to the cultivated area of Imperial County is one indication. The movements to raise large sums, \$1,000,000 in one instance and \$400,000 in another, to advertise the resources of northern California, is another.

There are ample reasons for this interest. Although in the value of her agricultural products California ranks fifth among the states, this wealth is drawn from a comparatively small portion of her productive land and is created by the labor of a still smaller fraction of the state's population. The last census shows that only 15 per cent of the people live on farms and in towns of less than 2500 people. Probably not more than 10 per cent live in the open country. We have, therefore, a one-sided development. In the last ten years our cities grew five times as fast as our rural population.

This was not due to a lack of desire on the part of American farmers to come to California, nor to lack of fertile land. Both of these exist. Development has halted and our great resources of land and water are unused because we have not made adequate provision for overcoming the obstacles which confront settlers on our unused or ill used lands.

A great influx of settlers and an enormous increase of wealth in land awaits the expansion of a policy of aid and direction which will tend to make rural life more attractive and give broader opportunities to men of moderate means. Recognition of these facts has directed increasing attention to the operation of the state land settlement act and to progress of the two settlements, Durham and Delhi, created under its provisions.

### THE STATE POLICY AND ITS RESULTS.

A few years ago California was wise enough to recognize the fact that the future well-being of the state called for the settlement of land upon the basis of the associated group or neighborhood and not merely the location of the isolated, independent farmer.—*Review of Reviews*, October, 1921, p. 397.

These two settlements have been created under legislation which gives settlers 36½ years' time in which to pay for farms with interest at 5 per cent on deferred payments. It provides for the creation of communities large enough to give the settlers the benefit of expert advice and direction and it enables them to cooperate in carrying out development and in the management of business affairs afterwards.

This report outlines the methods by which these policies have been given practical effect in helping settlers to improve their farms and meet their payments to the state. Under it, the Durham settlement lands, which unfriendly critics called "a malarial marsh unfit for human habitation," have become the home of 139 settlers and their families, all of whom are leading healthful contented lives. Delhi, which the enemies of the state's policy called "a wind-swept desert of shifting sand" has been transformed into alfalfa fields, orchards, and vineyards on which 217 families now live and where 400 families will live when the development is completed. On this land 10 tons of alfalfa to the acre have been harvested this year and dairy herds of settlers have repeatedly held first place in the monthly records of state cow-testing competitions.

Before the state bought the Delhi lands, the rental income was about \$4,000 a year. Competent experts predict that within 10 years the crops from this land will be worth \$1,000,000 a year.

#### ONE URGENT NEED FOR CLOSER SETTLEMENT.

While there are great opportunities for closer settlement in all sections of the state, it will be especially timely and valuable in the irrigation districts recently organized where reservoirs and canals have been built to water great areas of land but which are still growing crops that are watered by rain. For years we have been selling millions of dollars of bonds, secured by a first mortgage on the land, and with this money building canals and reservoirs to water land mainly held in large holdings. This land is either wholly unimproved or used to grow grain. It is largely owned by men who are not skilled in methods of intense culture. Few have the capital needed to improve and equip irrigated farms. They are, therefore, not in a position to meet interest payments on the debt for water. The income from land, and in the end, the value of irrigation bonds depend on the creation in these districts of small farms improved and equipped for intensive cultivation.

#### IRRIGATION CANALS DO NOT CREATE IRRIGATED FARMS.

We are beginning to learn, as other countries have learned, that building canals and reservoirs is not the remunerative part of irrigation development. An irrigation canal is a liability until the water is used. The money to pay water charges has to come out of crops. But before the farmer can begin to earn this money, the land must be cut up into farms of suitable size and they must be improved and equipped for irrigated agriculture. Changing raw land into improved small farms is the costly part of irrigation development. Few except settlers realize how much money it takes. Hundreds of millions of dollars have been lost in irrigation schemes because planned development stopped with canals and reservoirs. Irrigation enterprises are left to drift just at the point where management, money, ability and experienced direction would bring the largest returns. The great sums of money needed to build houses, grade land for irrigation, and buy farm equipment are either not considered or left to be provided by the burdened land owner or the oversanguine land buyer.

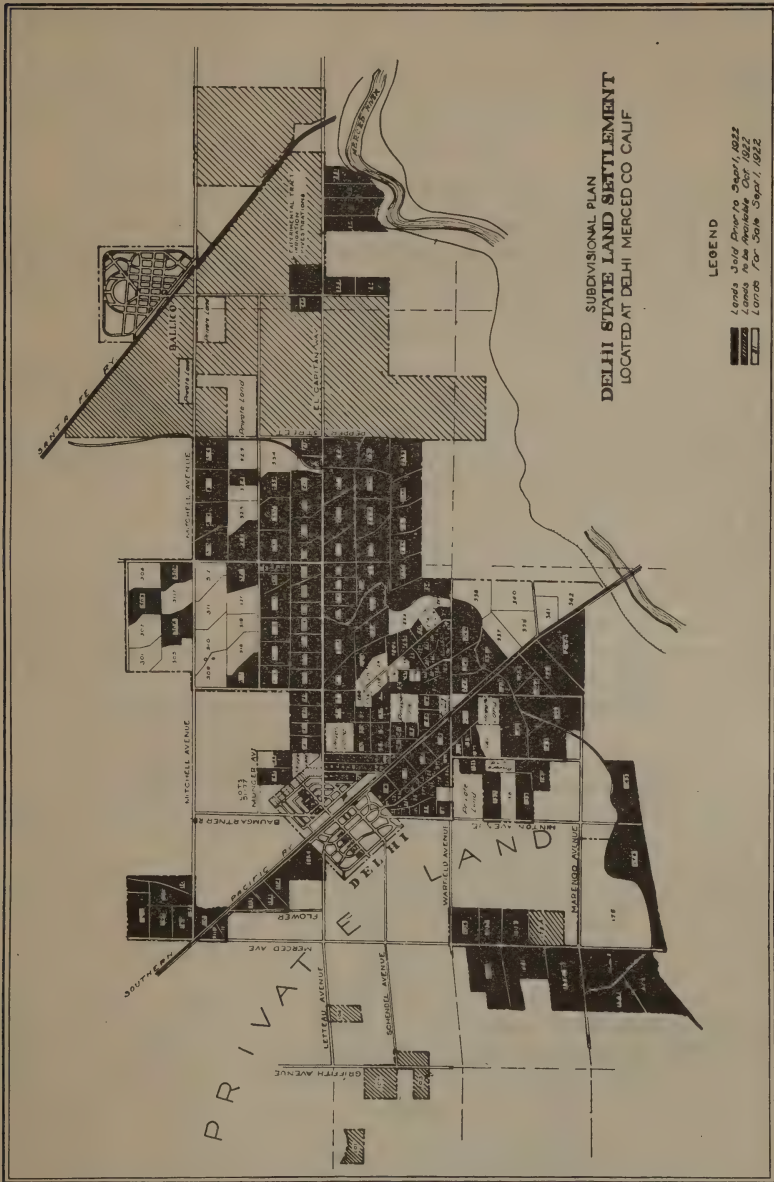


Figure 2. Map of Delhi Settlement.



Instead of being a detail, means and plans for financing the settlement and improvement of farms are necessary to rapid development of irrigated areas. Neglect to provide these things wrecks more irrigation schemes than all other causes combined. There is as much need for working out the right size of farms, the kind of agriculture, the cost of changing raw land into farms and creating conditions under which settlers can buy and pay for farms as there is for working out plans and estimates of cost of reservoirs and canals.

#### MORE THAN A LAND SELLING CAMPAIGN IS REQUIRED.

The state (California) already has an excess of irrigated land for which settlers are required. It needs money to finance new settlers far more than it needs additional irrigation facilities. Also, through established channels funds are steadily flowing into new irrigation enterprises but for scientific colonization of these new irrigation projects the available funds are totally inadequate.—Editorial, *Sunset Magazine*, September, 1922, p. 45.

When land sold for \$20 an acre and water rights were cheap, almost any hard working farmer could become a land owner in this state. Unplanned development brought results although it was never efficient. But when land costs from \$100 to \$200 an acre, and when it costs two or three times as much to improve and equip a farm as it did twenty years ago, it takes more than the arts of modern publicity to attract settlers and enable them to succeed.

During the past year a series of investigations have been carried on to determine what it costs to change the large tracts of grain or brush land into small intensively cultivated farms. Below is given the development expenses of about 70 farms varying in size from 20 to 40 acres and irrigated in some cases by water from gravity irrigation districts and in others by pumping plants lifting water from wells.

Table Giving Average Cost of Land and Average Capital Expenditure in the Development of 70 Farms in Typical Irrigated Areas.

	Per acre
Purchase price of land.....	\$160 00
<i>Expenses of Development.</i>	
Cost of district water rights or pumping plants.....	47 50
Cost of clearing, leveling and building laterals.....	76 00
<i>Cost of Buildings and Equipment.</i>	
House .....	25 00
Barns, outbuildings, fences.....	18 00
Farm implements.....	11 00
Livestock, including horses and cows.....	16 00
	<hr/> \$193 50
<i>Cost of Preparing the Land for Alfalfa.</i>	
Checking, bordering.....	16 00
Seed and seeding.....	8 00
	<hr/>
Total average cost of preparing an alfalfa farm.....	\$217 50

Total of expenses of development and cost of buildings and equipment from  
page 7 ----- \$193 50

*Cost of Preparing and Planting Orchards.*

Preparation of the land-----	15 00
Trees -----	30 00
Planting and care-----	10 00

Total average cost of developing an orchard farm-----	\$248 50
Adding purchase price of the land-----	160 00

Gives the total average cost of an orchard farm-----	\$408 50
--	----------

In the development of an orchard, there will be little or no income the first year and if we are to have a complete understanding of the settler's outlay, we should include the first year's operating expenses on either kind of a farm, which are about as follows:

*Cost of Operation for the First Year.*

Interest on capital expenditure-----	\$25 00
Taxes, insurance-----	3 00
Fertilizers -----	2 00
Irrigation -----	3 00
Annual charges for water-----	8 00
Labor, cultivation-----	11 00
	<hr/>
	\$52 00

Total investment at the end of the first year-----	\$460 50
--	----------

**COMMENT.**

We have adhered to a mistaken idea that once a man was sold a piece of land, he could in some way succeed. That was only true when land was free or low priced. The above figures convince anyone that it is not true today and these investigations have shown that the development costs, after the main canals have been built, are far greater than the cost of providing water and they are also greater than the purchase price of the land. Cutting land prices will not, therefore, as many have assumed, solve the settler's problems. If we want settlement to be rapid and successful, we must work out plans for doing in a wholesale and efficient way the things needed to change grain and brush land into small settlers' homes.

Under the state land settlement act, experts plan the development. There is teamwork in the settler's buying and the provision that the state can loan a settler up to \$3,000 to enable him to complete his development has been the life saver of many who would otherwise have exhausted their capital before the earning power of the farm had been established. The value of expert direction in clearing, leveling land, building lateral ditches, planning the location, making designs for houses, barns and outbuildings, and buying the material at wholesale can only be realized by those who have contrasted the delay, the cost, and the high percentage of failures in an unplanned development with what has taken place in the state settlements. It would of course obviate the need for this kind of organized direction of settlers and of making loans to them if the owners of large areas of land would im-

prove it themselves and then sell the farms to settlers as going concerns. But with a few exceptions like the improved fig orchards of J. C. Forkner of Fresno and the fine small improved farms of the San Fernando Valley, little in this direction has been done and the amount of capital it takes gives little hope that much will be done in the future.

#### HOW SETTLERS ARE AIDED BY SCIENTIFIC LAND SETTLEMENT.

The preliminary work done by the state at Durham and Delhi is a very good illustration of how much has to be done to whip raw land into shape. When the state bought these two tracts of land, they were regarded as ready for colonization and a part of both of them had been subdivided and offered to settlers, but before the state sold the land, it had done the following things:

##### At Durham.

1. Made a soil survey. The prices of farms were based largely on that survey. The soil map has been a valuable guide to settlers in cultivation.
2. Settlers' water right controversies on Butte Creek were settled.
3. Built a system of irrigation ditches reaching each settler's farm.
4. Built levees and drains to protect the land from floods or storm waters.
5. Organized a mosquito abatement district to protect the settlers from malaria.
6. Planted a large part of the land to crops.
7. Prepared plans of houses and made arrangements for securing wholesale prices on building materials.

##### At Delhi.

1. Prepared a soil map showing all the details of soil conditions to a depth of six feet over the entire area.
2. Prepared a contour map for each allotment showing the proposed location of the distributing pipe and proposed plan for the development of the allotment.
3. Constructed a concrete pipe system to carry water to each allotment; the total value of all the pipe installation amounts to nearly one million dollars.
4. Laid out roads and graded throughout the entire settlement. Ten thousand dollars worth of gravel was placed on the main roads the first two years by the county.
5. Prepared for irrigation a portion of the land prior to settlement. In practically all cases, engineering assistance was rendered settlers in the preparation of land for irrigation and in the orientation of orchards, vineyards, and buildings.
6. Prepared plans for houses, barns and poultry houses when requested, and in a majority of cases detailed plans and specifications were prepared, contracts let, and building supervised by the farmstead engineer.

There are also certain features of the state plan that are of great advantage after settlers have bought their farms.



Among these are:

1. The long period of payment and the low interest rate.
2. The fact that no profit has to be added to the land, as the motive is public welfare, and practically no selling expenses.
3. Securing lower prices by taking advantage of being able to buy material through the state purchasing agent.
4. Ability to buy land at the best possible figure through the competition of land owners in selling to the state.

Helping settlers to plan their development and to organize for working together in business has enabled the Durham dairymen to get an extra price for all the milk sold. It is saving Delhi settlers over 10 per cent on the cost of all their farm buildings. It enables them to buy better stock for less money and sell their hay, poultry, and eggs for better prices. Their dollars go farther because of this team work and expert direction. Yet with all this help, the struggle of many settlers to keep going and meet payments has taxed their courage, endurance, and resources to the limit. If they had been left to work alone or unaided, on many of these farms the state would now be an absentee landlord. As it is, only 13 settlers at Durham have sold their farms and only 8 have left the settlement. Only 17 settlers out of over 200 have sold their farms at Delhi. One hundred thirty-nine families live at Durham where no land owner lived four years ago and 216 live at Delhi where no land owner lived two years ago.

The American farmers in these settlements have come from 15 states. More than 100 ex-service men have found their opportunity in life in these settlements. Not all have been able to meet their payments on time and for the full amount but the arrears are remarkably small. In some cases settlers have been advised to use their capital to prepare the farms for irrigation and to plant trees and vines.

All that the state has done at Durham and Delhi will be needed to be done for settlers on 15,000 acres awaiting development in the Happy Valley District, on 100,000 acres in the Merced District, on 250,000 acres in the larger Madera District, and on the 300,000 acres when it is reclaimed in the Imperial Valley. What the state has done, therefore, is correctly stated by Arthur Ruhl in the August number of Harper's Magazine as being "*Nothing untried or unduly paternalistic. We have merely done what has been done in Europe long ago—loaned to the individual for the benefit of all some of the state's surplus capital and expert intelligence.*"

#### HOW THESE SETTLEMENTS HAVE ADDED TO THE STATE'S WEALTH.

Durham settlers have invested more than \$400,000 of their own money in buildings, leveling land and planting orchards. That adds to the state's security. Delhi settlers have put half a million dollars of their own capital into farms to which the state holds title. Nothing except complete collapse of rural values can prevent the state receiving back all the money invested. Durham has a surplus of \$142,000. Delhi \$250,000. The latter will be reduced before development is complete but the hard problems have been solved. The land is being sold at prices which will repay the state and still leave it a bargain for the

home seeker. The applications on file for Delhi farms to be thrown open during the winter 1922-23 give every reason for confidence that all will be taken.

#### **THE CAPITAL A SETTLER SHOULD HAVE.**

No feature of state land settlement has given rise to more controversy than the requirement of the provision that the buyer of a farm should have at least \$2,500 and this question is constantly raised because many more people with less than this amount of money try to buy farms than apply who have more than this amount. It is, of course, impossible to fix a hard and fast line which would determine where a settler would succeed and where he would fail because of the difference in settlers, but four years' experience makes it certain that no one should attempt to buy a farm unless he has money enough to make his land and improvement payments for the first year and enough to pay 4 per cent on his entire development program. If he cannot do this, interest payments are going to be a load that will break most settlers.

It must be remembered that time is a most important element in the settler's success. Delays mean added burdens from accumulated interest payments and the settler's program should be so worked out that his own capital with the aid that the state gives will enable him to bring his land into full development at the end of the second year and to have a considerable part of it growing crops at the end of the first year.

#### **STATE SETTLEMENTS ARE PRACTICE SCHOOLS IN AGRICULTURE.**

If the sole purpose of the state land settlement act was to demonstrate the value of planned development, then the results already obtained would justify all the state has done. These settlements have shown that no more effective means can be devised to stop the drift of land born people to the cities and bring Americans back to the land. The business and social meetings of settlers in the transformed bunkhouse at Durham and in Wilson Hall at Delhi are teaching people to understand and love the soil, to manage animals and grow crops, and to understand the business of agriculture. No training school in this country shows better results than the one at Delhi in helping injured ex-service men regain their health and enjoy landed independence at the same time.

#### **THE DEMOCRACY OF THE FARM LABORER'S ALLOTMENT.**

It is perfectly feasible, as it has already been proven at Durham, for a laborer to advance in a few years to a small farm and it is also possible for a farm laborer to remain a farm laborer and yet to live a much more comfortable and self-respecting life than the ordinary landless farm laborer lives.—Leslie's Illustrated Weekly, December, 1921, p. 773.

The farm laborer's allotment is the greatest contribution to economic democracy and rural life which has been made since the disappearance of free land. It enables the man who works on the farm for wages to have a home of his own, to have a house, garden, shade, and fruit. It

gives to his wife and children the same sense of security and independence that are enjoyed by families of the farm owners. What people think of these homes is shown by the fact that last year 5000 people wrote to the Berkeley Land Settlement Office applying for one of these laborer's allotments or asking how they could get one. What settlers have done to improve these little patches of land, the promptness with which they have made their payments, and the fact that three of them have already saved enough to buy farms shows that the American will live in the country and will do the hard labor of the farm if he is given the right social and economic status. What he will not do is to stay in the country if he has to live in a bunkhouse or if his wife and children are denied social recognition.

At Durham and Delhi the farm laborers take part in the business meetings. They and their wives and children attend the community dances, take part in all the community functions, and meet with the families of farmers on a plane of unquestioned equality. Under such surroundings, farm labor takes on a new dignity. It opens up the door of opportunity to the boys and girls and helps to make them the farm owners of the future. Wilson Hall at Delhi and the settlers' community park at Durham are the centers of a social activity that is bringing back to rural civilization those interests and enjoyments that are native to the country and which must be developed to enable agriculture to withstand the influences and attractions of the city.



Figure 3. House on Farm Laborer's Allotment P, Durham Settlement.



### STATE POLICY EFFICIENT.

Already firmly established in California, the community land settlement idea is now sweeping the country—the governments of many eastern states are studying the plan with a view to its adoption in reclaiming abandoned New England farms and the great stretches of unused land in Maryland and the old south.—*Collier's*, July 29, 1922, p. 26.

There are inserted in these pages brief quotations from recent discussions in important journals and reviews of the need of efficient methods for placing people on land as owners and of creating conditions which will make rural life more attractive and thus stop the drift of intelligent and aspiring people to the cities. These quotations show better than argument how widespread is this interest and how sympathetic is the approval of the efforts California is making to solve the fundamental problem of rural civilization.

During the past twelve months articles similar to those quoted have appeared in over a hundred magazines or reviews. They express the thoughtful opinion of our time. To this outside discussion there has been added an active interest in the progress of these settlements and with few exceptions a warm approval of the state's policy which created them by the state press. The interest thus created is reflected in the volume of correspondence which comes to the Berkeley office from all parts of this country and other countries asking for information about the policy and the method of making applications for farms.

During 1921 there were over 10,000 letters asking the conditions on which farms or farm laborers' allotments could be obtained. This interest in California and appreciation of the state's efforts to broaden the opportunities of poor men has been a great aid to rural progress outside of these settlements and it has made the securing of settlers for these colonies a matter of small expense and of no uncertainty. The settler gets the benefit of this and it is an important aid to his success. Recently inquiries were made as to the cost of capturing settlers in important colonization enterprises in different parts of the country. In Canada each settler costs on an average \$1,000. In Florida, Texas, and parts of the Middle West the cost ranges anywhere from \$500 to \$1,200 a settler. On the very high priced land of California it has reached as high as \$200 an acre and generally speaking it costs one-fourth of the selling price of the land.

The state settlements are a great contrast to this. There the only expenses have been the legal advertising which the law requires, the printing and mailing of circulars of information, and the expenses of a man and automobile to show land seekers over the property. "In all it does not amount to 1 per cent of the selling price of farms."

The Santa Fe and the Southern Pacific railroads have been of great assistance in securing a desirable type of settler. Through their agents and in other ways they have done much to make the country acquainted with the opportunities offered by the state settlements. The same is true of the state press which has kept the public informed regarding the progress of these settlements and the opportunities they present. In the main, however, the chief magnet has been the fact that the state offers men of industry and thrift, who have a little capital, a better chance to succeed, and gives them a more attractive social life, than can be secured under any unplanned development.

This reconstruction of rural life, the appeal it makes to young men and women, justifies a large expenditure by the state aside from any gain in wealth or population. But the reason for its continuance and extension does not rest on this but on the showing made that it is the most efficient and successful plan for bringing to full fruition our unused agricultural resources that has yet been tried or proposed. Wherever there are 5000 or more acres to be settled, no other plan will do as much to make the state the mecca of the best type of American farmers. None other will as quickly bring relief to land owners burdened with water charges or make secure our millions of dollars of irrigation bonds.

#### STATE SETTLEMENT AIDS PRIVATE DEVELOPMENT.

For years our arid states and the federal government have been grappling with the problem of failures on irrigation projects—it has remained, however, for the State of California to put in hand the first experiment in this country which strikes at the root of the evil.—Engineering News Record, December 5, 1918.

The opposition to continuing this policy comes in part from those who do not realize how far we have traveled from pioneer conditions. It comes from those who think the settler can still hoe his own row as he did when land was free. Many favor leaving settlement wholly to private enterprise because they object to the state managing any kind of business. That argument was once used against public schools and against the postoffices. They point out that the efforts of some private colonizers have undergone a radical change. Experience has shown them that it is worth while to care for the settler after he has been transplanted from his old into his new home. They say truly that some broad minded colonization companies are adopting the policy of extending generous aid to settlers. Some build houses, provide the settler with cows, pigs, and chickens, and hire some one to act as an advisor. The cost of these services is added to the price of the land. Some companies go further. They let settlers put all their money into improvements and allow land payments to be deferred for several years.

Not all, or even a majority of land selling agencies, however, are able to adopt this broad public policy and none of them can give the settlers as good interest rates as the state land settlement act gives which is a vital feature in the settler's progress and ultimate success. A majority find it easier to take the settler's money and forget him. Sooner or later, in all developing sections, the state has to take action to protect the settler from unfair practices or the mistakes of his inexperience. State regulation is, however, negative in its operation. It does little to aid or hasten development. Some states, notably Wisconsin, are helping to secure and finance settlers by having the state banking department approve the securities of colonization companies, the agricultural department to examine and certify to the character of the land and the immigration department to help make settlers understand what the state has to offer and to feel that they are welcome additions to its population.

Wisconsin has adopted a plan suited to the conditions of its cut over land which costs only a few dollars an acre and where nothing but

labor is required in its reclamation. It would be wholly inadequate as a means of financing the development of large holdings in California where land is high priced and where intensive culture requires that the farmer shall live in a good house, use good tools, and take advantage of all that science and skill can furnish.

The fact remains, also, that the greatest rural progress in the last third of a century has been achieved in countries which have adopted methods and policies closely resembling ours. Ireland, Germany, all the Scandinavian countries, Australia and New Zealand have each invested hundreds of dollars where we have appropriated one. They are doing it to increase wealth, to make themselves independent of outside nations, to hold people on the land, to check the increase in tenancy and end dangerous political unrest. The best citizen is the one with a stake in the land.

During the last two years the land settlement division has had many requests to buy large tracts of irrigated land. These have come from land owners and from the civic bodies of localities. Proposals have been made to sell land without any initial payments, the land owners to wait until the payments were made by settlers. What was wanted was the benefit of the land settlement organization and the expert direction of its officials. These requests for cooperation in development have aroused the sympathetic interest of all connected with land settlement work and the division has cooperated with these land owners in the study of their problems and their efforts to work out a solution.

In these investigations the University of California and the California Development Association have cooperated with this division in meeting the expenses of the investigation and working out problems. After this situation is studied, there is a cumulative impression that nothing is more needed than a definite program for the rapid development of a million acres of land that await settlement. If this is to be carried out, no single aid will be of more value than the \$3,000,000 bond issue authorized by the last legislature.

#### A \$3,000,000 BOND ISSUE FOR NEW SETTLEMENTS.

Eighty-eight per cent of the land in Denmark is being cultivated by small freeholders, who number 180,000. As fast as the few remaining big estates come into the market for splitting up they are outparceled to farmers and laborers who do not have to pay anything down on taking it over but pay a half-yearly tax of two and a quarter per cent on the amount at which the land was valued. They get help in building, payable by amortization—and the whole scheme is fundamentally similar to the colony of the State of California at Durham.—*The Country Gentleman*, September 16, 1922, p. 19.

At the last session of the legislature, provision was made for financing future colonies through the sale of state bonds. The reason for this action was that it could be better financed by the sale of bonds than by making appropriations from the state treasury. This action if approved will give settlers the benefit of low interest rates and long time credits on many millions of dollars because it will enable a large use to be made of federal land bank loans along the lines followed in the development of Durham and Delhi.

The policy thus briefly outlined will impose no added burdens on taxpayers. Our brief experience in California agrees with the long



experience of Europe, Australia, and New Zealand. All show that state land settlement can be made a solvent enterprise. The settlers repay all the money advanced, with interest. It gives social and economic benefits not obtained by private colonization because the state can command the requisite financial credit on better terms, state experts are particularly competent to select and acquire the land needed, and the state, through its agricultural departments and the College of Agriculture, has precisely the knowledge and influences needed to protect these farm communities against mistake and give practical application to the policies that are essential to their success.

There is no financial reason therefore why this bond issue should not be unanimously approved. The bonds will be secured by the lands purchased, by the capital and labor of settlers, and by the increase in land values which closer settlement and developed farms will bring.

## REPORT OF THE PROGRESS OF THE DURHAM STATE LAND SETTLEMENT.

Earlier reports told how the first two units of the Durham State Land Settlement were made available in 1918 and all the farms sold. A portion of the tract could not be sold then because in 1917 it had been leased for five years. Arrangements were made with the lessees which enabled the Division to plow the land and sow it to oats in the fall of 1921 and throw it open to settlers in 1922. Necessary structures and ditches were constructed to adequately irrigate the allotments. Seventeen farms and six farm laborers' allotments were offered to settlers and all taken except three farms having a total area of 89 acres. These were applied for, but the applicants lacked capital. Buyers found their farms carrying a fine oat crop which yielded as high as three tons of hay per acre. This gave settlers an immediate cash return, and the crop was taken off early enough to permit a second crop, such as corn, beans, sudan grass, milo maize or garden stuff to be grown this year. Settlers also had ample time to plant alfalfa and orchards and begin their permanent agricultural development.

There remains 38 acres in the headquarters and 750 acres of pasture land to be disposed of later. All of this land is leased for grazing or farming purposes. Every acre of land is therefore a source of revenue to the state.

There are now 139 families on the settlement, made up of 105 farmers and 34 farm laborers. The laborers' blocks vary in size from one to three acres. They are used for vegetable gardens and fruit growing. The farms are mainly devoted to growing food for dairy herds and grain. Each year sees an increase in the fruit-growing area.

TABLE GIVING ACRES OF CROPS IN 1922.

Crop	Acres
Alfalfa .....	1,368
Grain and grain hay .....	1,622
Beans .....	145
Silage corn .....	103
Milo maize .....	132
Pastures, summer fallow, etc. ....	1,649
Garden (commercial and home) ..	68
Orchards .....	156
Miscellaneous crops .....	76
Total .....	5,319

Thirteen farms have been resold to new applicants by the original applicants, the sale in each case being approved by the Division. Eight of those selling carried away more capital than they brought to the settlement. Four were transferred from their original holdings to others more suited to their needs. Two who started on farm laborers' allotments, and one farm laborer who worked on the settlement, so increased their assets as to be able to buy small farms in the settlement.

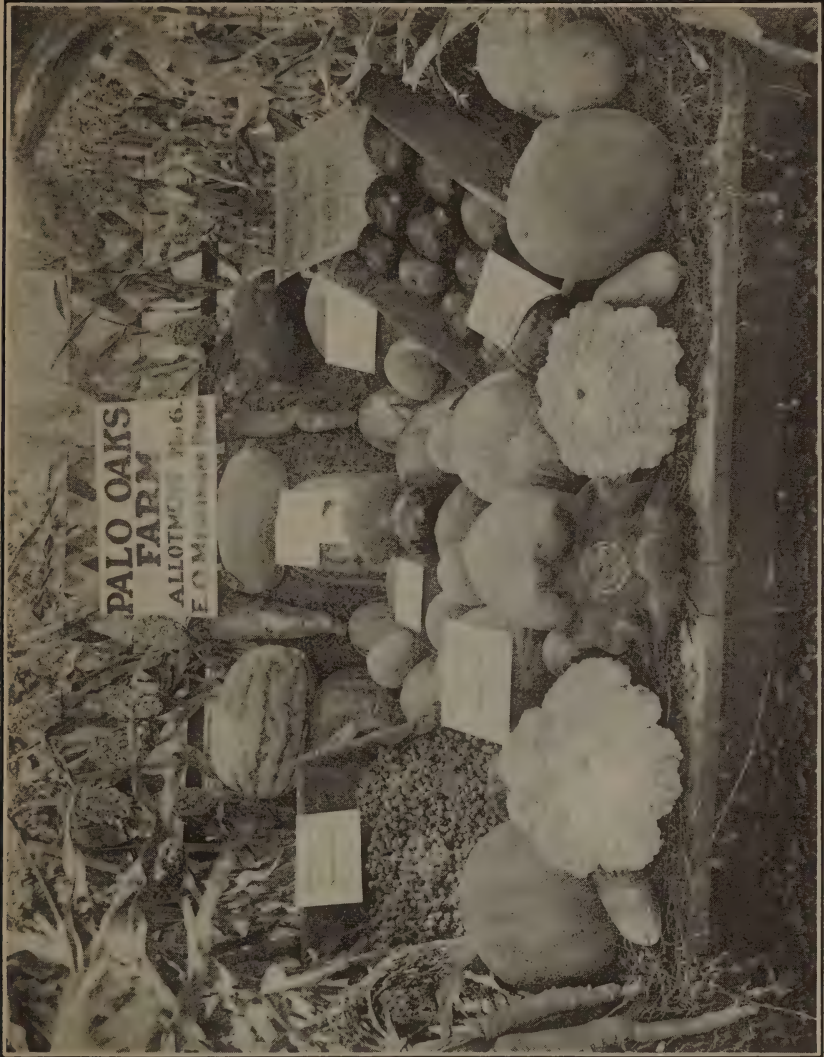


FIGURE 4. Exhibit of Farm Products at Durham Community Fair, August, 1920.



One farmer sold his farm and bought a farm laborers' allotment. Six farms further subdivided now accommodate at least two families where only one lived at first.

The trend at Durham has been toward smaller farms. Settlers with only the land they could farm with the help of their families have done better than those who had to employ hired help or fail to cultivate.

Transfers and changes in size of the original farms have helped settlers get adjusted. It has promoted development and the satisfaction of those involved.

#### **Cooperative Organization.**

Earlier reports have told how settlers were helped to form a cooperative stock breeders' association. Under this they agreed to have only one breed of dairy cattle (Holsteins), one breed of hogs (Durocs). Only purebred registered sires were to be allowed on the settlement, and at first all the bulls were purchased by the association and owned by it.

It was to be a tubercular-free settlement. All cows were to be tested before purchase, and if the disease developed afterwards the infected animals were to be sold.

All these conditions have been maintained during the last two years with the exception that the association-owned bulls have been sold to breeding centers.

Other cooperative organizations have grown out of the parent one. The Dairymen's Milk Chilling Association provides facilities for collecting, testing and chilling the milk of the community. The Durham Cold Storage Company has built a chilling plant to prepare milk for shipment in the summer and provide refrigeration space in which the different settlers rent boxes and are able to hold fruit, milk and fresh meat as long as desired.

The Dairymen's Milk Selling Association has been a convenience and a money-making institution for the settlers. Instead of each settler having to operate a separator, this is all done by power at a central plant and the large supply which the community furnishes brings it more buyers than would care for the product of a single farm. Durham milk is now sold in the markets of Chico, Oroville, Colusa, Biggs and Sacramento. The sanitary character of the dairies and the fact that the milk is free from any taint of tuberculosis gives it a high reputation. One school at a considerable distance gets ten gallons of milk daily from the Durham plant to feed its children.

The settlers incorporated to build the refrigeration plant. The Land Settlement Division loaned them part of the money needed to complete and equip it. Its machinery is automatic. It chills the milk and holds the cool room automatically at a definite temperature. This cool room has 120 individual boxes which hold from 150 to 300 pounds of fresh meat. These are rented by settlers, and it has led to the local slaughtering of beeves, sheep and hogs throughout the season and is saving the settlers from paying the retail prices at the local shops. Ice is also sold by this plant at cost to those farmers on the settlement that desire it.

From a small beginning of \$40 a week, the Dairymen's Milk Selling Association has grown to a business of more than \$60,000 a year. The problem of marketing milk is of so much importance that it seems to warrant a full description of the methods adopted at Durham.

The milk is taken from each farm to a small plant at headquarters and it is divided into two classes, whole milk and milk to be skimmed and the cream sold as sweet cream. The skimming is done with a large turbine separator of 3200 pounds capacity per hour. It is separated by power and relieves each farm of disagreeable labor and time wasted in cleaning a large number of machines. The product is kept up to standard by daily tests of each member's product as it comes to the platform. The cream when received is run over a brine cooler and brought down to a temperature of 35 degrees, after which it is placed in the chilling room awaiting shipment. Whole milk is taken care of at the same time as the cream, utilizing a large tubular milk cooler and aerator. Whole milk is likewise chilled to 35 degrees and stored for shipment. Tests are made for acidity and sediment, which are indications of its bacterial content. In addition to this constant oversight by the operator of the central plant, the state dairy inspector takes platform samples intermittently for bacterial content. The settlers, who are directors of the association, make regular inspections of all the dairy units and insist on a high standard of cleanliness and equipment. There is a constant striving on the part of members to produce a better product in order to extend the market for whole milk, which pays better than cream. Concrete milking floors, separate milk houses, tubular water coolers and clean utensils are insisted upon.

The output is pooled and is not sold as the product of any particular farm, but as of the Durham Settlement. The dairymen are paid in accordance with the amount each member supplies and the price is based on the butterfat content. Testing for butterfat is done by the operator of the association, who is a licensed tester under the present law. The cost of operating the central plant is 5 cents a pound for all sweet cream based on its butterfat content and 1½ cents per gallon for whole milk. It seems to be large enough to pay for the cost of operating and also to provide funds for the purchase of new equipment. This operating expense is deducted from the amount each supplier receives.

Payments are made twice a month. Each member receives a statement on his voucher check of the milk he supplied, showing gallons, test of butterfat, price obtained, cost of operating and net amount to him. This keeps him posted about the operations of the association. In addition, the members meet once each month. At this meeting the members talk over needed improvements, economies in operations, seeds and seeding, and any other things that enter into the efficient production of dairy products.

Durham settlers had the help of high war prices for their products in 1918 and 1919. Against this they improved their farms when all costs were high. Then in 1920 and 1921 they went on the toboggan, when the prices of farm products collapsed, when their purchasing

power as compared to operating costs shrank as is shown in the diagram below:

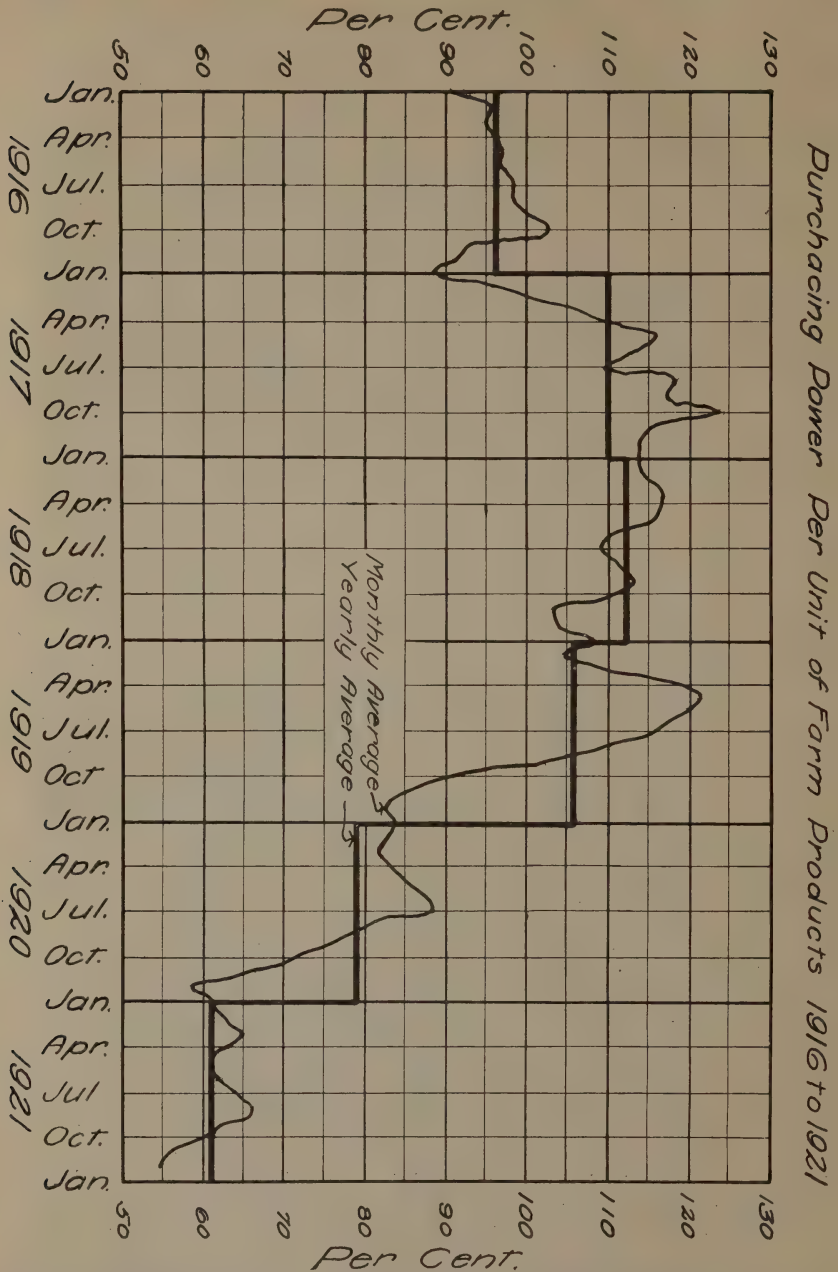


Diagram Showing the Decline in the Price of Farm Products from 1919 to 1922 and the Relation of This to the Cost of Buying and Operating Farms.



It will be seen that from January 1, 1919, to January 1, 1922, there was a drop of nearly 60 per cent in the purchasing power of what the Durham farmer had to sell.

This diminished value of what the settler had to sell is reflected in the settlers' payments.

The first two years they were made with remarkable promptness and for the full amount due, but as prices dropped the strain showed in the Division's receipts. Instead of being made promptly and for the full amount, payments would be made as the settler could raise the money and in whatever amounts he could get together.

If the Durham settlers had all had to depend on the local banks for money for development, half of them would have lost their farms during the last two years and the state would have been a nonresident landlord. In order to illustrate how narrow the margin is between success and failure, a complete statement of the expenses and income of two of them is inserted. The first is a settler who had experience in irrigated farming and who could take full advantage of all his opportunities.

**Statement of a Typical Settler's Experience in the Purchase and Development of a Durham Farm, as Shown in the Record of Expenses and Income of John Doe in the Durham State Land Settlement.**

Contract of purchase dated June 15, 1918. Date of actual settlement November 20, 1918. Approximately 44 acres at \$227 per acre; 30 acres graded and seeded to alfalfa at time of settlement; 10½ acres additional pasture land at \$25 per acre. Total value of land, \$10,280. Cost of preparing land for irrigation, seeding to alfalfa and building ditches, \$1,892. Total cost of land and improvements, \$12,172.

*Assets at Time of Settlement.*

Cash .....	\$4,250 00
Live stock .....	300 00
Farming equipment .....	350 00
Household goods .....	400 00
Automobile .....	700 00
<b>Total .....</b>	<b>\$6,000 00</b>

*Operating Account to December 31, 1918.*

EXPENSE.		INCOME.	
Deposit on land .....	\$534 54	Cash on hand .....	\$4,250 00
Deposit on alfalfa and grading .....	718 24	Sale of hay which was operated on share basis .....	765 00
Installments, land .....	390 68		
Installments, improvements .....	42 96		
Additional interest .....	2 24		
Barn and shed built .....	785 00		
Irrigation water .....	20 63		
Taxes .....	51 40		
Supplies and labor, living expense November 20 to December 31 and miscellaneous farm expense .....	269 31		
Cash in bank December 31, 1918 .....	2,200 00		
	<b>\$5,015 00</b>		<b>\$5,015 00</b>

Started next year, 1919, with \$2,200 cash, but house not yet built.

*Operating Account to December 31, 1919.*

EXPENSE.		INCOME.	
Deposit on house.....	\$888 00	Balance cash on hand.....	\$2,200 00
Interest to June 30.....	6 16	Sale hay, milk, hogs and other	
Interest to December 31.....	30 00	farm income.....	3,400 00
Fruit trees and seed.....	50 00		
Nine cows purchased.....	1,280 00		
Land payments.....	781 36		
Improvement loan.....	95 92		
Irrigation water.....	76 50		
Grain for hog feed.....	150 00		
Fences erected.....	200 00		
Taxes.....	252 00		
Fire insurance.....	80 00		
Labor.....	240 00		
Paint.....	60 00		
Plumbing.....	17 00		
Gas, tires and repairs to auto	75 00		
Blacksmith.....	20 00		
Household goods.....	60 00		
Veterinary fees.....	7 50		
Doctor services.....	25 00		
Well and pump.....	152 00		
Milk house.....	40 00		
Milk cooler and cans.....	37 50		
Miscellaneous farm expense...	70 00		
Living expenses.....	800 50		
Cash on hand December 31....	105 56		
	<hr/> \$5,600 00		<hr/> \$5,600 00

*Operating Account to December 31, 1920.*

Started this year with \$105.56 and all debts paid—cows producing and feed on hand.

EXPENSE.		INCOME.	
Tank house and domestic		Balance on hand.....	\$105 56
water system.....	\$844 00	Sale hay, hogs, milk and mis-	
Land payments.....	393 63	cellaneous farm income....	5,200 00
Part land payments, Decem-			
ber 31.....	300 00		
Improvement payments.....	43 28		
Improvement payments.....	48 36		
Miscellaneous supplies.....	7 50		
Grain for hog feed.....	90 00		
Veterinary fees, contract....	28 00		
Baling hay.....	256 00		
Labor.....	395 00		
Taxes.....	206 00		
Half bull and manure spreader	195 00		
Auto expense.....	100 00		
Doctor expense.....	25 00		
Living expense.....	1,125 00		
Milk can.....	5 00		
Miscellaneous farm expense...	418 79		
Actual expense serious illness			
for several months.....	675 00		
Cash on hand December 31....	150 00		
	<hr/> \$5,305 56		<hr/> \$5,305 56

*Operating Account to December 31, 1921.*

Started this year with \$150 in the bank.

EXPENSE.		INCOME.	
Payment improvements contract	\$43 49	Balance on hand	\$150 00
Payment improvements contract	43 47	Sale of hay, hogs, milk and	
Payment improvements contract	48 59	miscellaneous farm income	3,280 00
Payment land contract	48 57		
Payment improvements contract	100 00		
Payment land contract	200 00		
Payment land contract	94 10		
Payment land contract	300 00		
Payment irrigation charge	99 72		
Payment supplies	22 25		
Labor and baling hay	365 00		
Taxes	232 00		
Heifer	65 00		
Insurance	55 00		
Electric wiring and equipment	125 00		
Washing machine	137 50		
Milk cans	9 00		
Paint	35 00		
Auto expense	100 00		
Blacksmith	35 00		
Fences	100 00		
Veterinary fees, contract	28 00		
Doctor bills	25 00		
Miscellaneous farm expense	200 00		
Living expenses	819 00		
Cash on hand December 31	99 31		
	<hr/>		
	\$3,430 00		<hr/>
			\$3,430 00

*Operating Account to Close, December 31, 1922.*

Commenced new year with \$99.31 and year will not close until December 31, 1922.  
Has following available credits:

Cash in bank	\$300 00
Hay on hand—50 tons at \$12	600 00
	<hr/>
	\$900 00
Owes at present:	
To state—	
Improvements contract	\$86 99
Improvements contract	97 20
Irrigation water	86 13
Stores (pipe, etc.)	8 00
To outside creditors—	
Supplies	50 00
	<hr/>
	328 32
Balance available for operating	<hr/>
	\$571 68



# STATEMENT OF ASSETS AND LIABILITIES.

As of August 1, 1922.

ASSETS.		LIABILITIES.	
Land (original value)-----	\$10,281 19	Land, balance deferred principal-----	\$8,487 12
Cash on hand-----	300 00	Improvements loan, deferred principal-----	933 26
Dwelling house-----	2,500 00	Installment owing-----	86 99
Barn-----	700 00	Improvement loan, deferred principal-----	1,105 39
Tank house and water system-----	1,000 00	Installment-----	97 20
Tool shed-----	150 00	Irrigation charge-----	86 13
Milk house-----	40 00	Irrigation pipe-----	8 00
Grading and alfalfa-----	1,830 00	Miscellaneous account payable-----	50 00
Fences-----	370 00		
Gravel roads, etc.-----	100 00		
Clearing-----	125 00		
Corrals and bull pen-----	125 00		
Septic tank-----	60 00		
Family orchard-----	100 00		
Electric equipment-----	125 00		
21 cows and half bull-----	1,800 00		
1 sow and pigs-----	75 00		
2 horses-----	300 00	Net worth-----	11,037 10
Poultry-----	70 00		
Wagon, plow and harrow-----	115 00		
Mower and rake-----	80 00		
Harness and small tools-----	65 00		
Hay derrick-----	40 00		
Car-----	250 00		
Dairy equipment-----	40 00		
Half manure spreader-----	100 00		
Household goods-----	550 00		
Hay, 50 tons at \$12-----	600 00		
	<u>\$21,891 19</u>		<u>\$21,891 19</u>

The loans made were as follows:

June 15, 1918, alfalfa deposit-----	\$718 24—deferred	\$1,074 00
May 24, 1919, house deposit-----	888 00—deferred	1,200 00
	<u>\$1,606 24</u>	<u>\$2,274 00</u>

Net worth, 1922-----\$11,037 10

Net worth, 1918-----6,000 00

Gain in four years-----\$5,037 10

The settler lives in a good house, has good stock, sends his children to school. The family is active in all the community organizations. In spite of the hard times he has prospered.

## What Would Have Happened Under Short Time Payments.

It is interesting, however, to consider what would have been his position if he had purchased the same farm privately and been compelled to depend on local banks for money needed to make improvements. If he had bought the farm on terms usually given in private contract, that is, one-fourth down, balance in ten-year amortized payments with interest at 6 per cent per annum, then borrowing for development would have been imperative. For this money he would have had to pay 8 per cent at the local banks, and there was a considerable part of the time during the last four years when it was difficult to borrow at all, even on the best of security. This settler would have only his chattels and equipment to offer as security. If we assume that his living expenses, insurance, irrigation water, cost of improvements, taxes, labor and income would be the same as he actually experienced,

the difference would be in interest and in land payments. He would not have done this well, because, if he had been outside the settlement he would have not had the economies of our cooperative marketing arrangement and he could not have obtained the price for milk that the Durham settlers have secured.

Table Showing what Would Have Happened to John Doe if He Had Bought His Durham Farm on a Ten-Year Payment Plan with One-fourth Down and 6 Per Cent Interest.

*Operating account to December 31, 1918.*

EXPENSE.		INCOME.	
Deposit on improved land, one-fourth of \$12,172.24	\$3,043 08	Cash on hand	\$4,250 00
Barn and shed	785 00	Sale of hay	765 00
Irrigation water	20 63		
Taxes	51 40		
Supplies, labor, living expenses and miscellaneous	269 31		
Cash in bank December 31, 1918	845 58		
	<hr/> \$5,015 00		<hr/> \$5,015 00

*Operating account to December 31, 1919.*

EXPENSE.		INCOME.	
Land payment, one-tenth of \$9,129.16	\$912 92	Cash on hand	\$845 58
6 per cent on \$9,129.16 for year	547 75	Income from farm	3,400 00
House	2,088 00	Loan on 50 per cent value of cattle and equipment	1,000 00
Fruit trees and seed	50 00		
Interest on loan of \$1,000 for 6 months at 8 per cent	40 00		
9 cows purchased	1,280 00	Deficit	2,159 09
Irrigation water	76 50		
Grain for hog feed	150 00		
Fences erected	200 00		
Taxes	252 00		
Fire insurance	80 00		
Labor	240 00		
Paint	260 00		
Gas, tires and repairs to auto	75 00		
Blacksmith	20 00		
Veterinary fees	7 50		
Doctor services	25 00		
Well and pump	152 00		
Milk house	40 00		
Milk cooler and cans	37 50		
Miscellaneous farm expenses	70 00		
Living expenses	800 50		
	<hr/> \$7,404 67		<hr/> \$7,404 67

The deficit of \$2,159.09 could have been reduced by building a very cheap house, costing, say \$1,000, or a shack costing about \$500. The latter would cut his deficit to \$571.09, which would have been owing on land. As he has come to the point where no ordinary agency would extend credit of \$2,159.09 it must be assumed that he built the cheap house and started 1920 in arrears, owing on his payment contract \$571.09.

*Operating account to December 31, 1920.*

EXPENSE.		INCOME.	
Deficit from 1919-----	\$571 09	Cash on hand December 31, 1919-----	Nil
Land payment, one-tenth of \$9,129.16-----	912 92	Sale of hay, hogs, milk and miscellaneous farm income-----	\$5,200 00
6 per cent on balance land, \$8,216.24, for one year-----	492 97		
Interest on live stock loan-----	80 00		
Miscellaneous supplies-----	41 76		
Grain for hog feed-----	90 00		
Veterinary fees-----	28 00	Deficit -----	1,261 53
Baling hay-----	256 00		
Labor-----	395 00		
Taxes-----	206 00		
Half bull and manure spreader-----	195 00		
Auto expense-----	100 00		
Serious illness for several months and doctor fees-----	700 00		
Living expense-----	1,125 00		
Milk can-----	5 00		
Miscellaneous farm expense-----	418 79		
Tank house and domestic water system-----	844 00		
	<u>\$6,461 53</u>		<u>\$6,461 53</u>

This deficit of \$1,261.53 could only be allowed as owing on land as he still owes \$1,000 on live stock and equipment.

*Operating account to December 31, 1921.*

EXPENSE.		INCOME.	
Deficit from 1920-----	\$1,261 53	Cash on hand December 31, 1920-----	Nil
Interest on deficit at 6 per cent for one year-----	75 69	Sale of hogs, hay, milk and miscellaneous farm income-----	\$3,280 00
Land payment, one-tenth of \$9,129.16-----	912 92		
6 per cent interest on balance land, \$7,303.32, one year-----	438 20		
Interest and principal on stock loan-----	1,080 00	Deficit -----	2,543 31
Irrigation charges-----	99 72		
Supplies (miscellaneous)-----	22 25		
Labor-----	365 00		
Taxes-----	232 00		
Heifer-----	65 00		
Insurance-----	55 00		
Milk cans-----	9 00		
Paint-----	35 00		
Fences-----	100 00		
Veterinary fees-----	28 00		
Doctor's fees-----	25 00		
Miscellaneous farm expense-----	200 00		
Living expense-----	819 00		
	<u>\$5,823 31</u>		<u>\$5,823 31</u>

As the live stock loan could hardly have continued as long as this, it is assumed that this is paid and default made on the land payment. He would have had to forego the electric lights and electric washing machine which he now has and which make his wife enjoy living on the farm. If he had built a house as good as the one he did build at Durham, his deficit in January, 1922, would be \$4,131.31. No ordinary vendor would allow it to reach this sum. It would be a hopeless



situation and John Doe would by now be moving back east or farming land as a tenant.

The stand of 30 acres of alfalfa which was on the farm when John Doe bought it gave him quick returns. Without this he states his comfortable house could not have been built. Something much cheaper would have had to answer.

This statement for 1921 shows how hard he was hit by the fall in farm prices. With more land under cultivation, more producing cows in his dairy and more to sell in every line, his income was \$1,920 less than for the previous year. He milked three more cows in 1921 than in 1920, but the cream checks in 1921 totaled \$1,560. Those in 1920 amounted to \$2,040.

He cut his living expenses and pulled through by saving and working harder. His payments on land and improvements were made in smaller sums and could not all be met when due.

#### **Balance Sheet of a Settler Who Is in Arrears.**

The statement of Richard Roe which follows is of an honest, intelligent, hard-working settler who had not had irrigation experience. He had been a grain grower like his father. When he came to Durham he wanted to follow the kind of agriculture he understood. He was also a mechanic and could earn good wages outside the farm. Against advice he tried to keep on growing grain and combine with this, working for wages. This accounts for the large labor income shown each year.



FIGURE 5. Prune Orchard on the Durham Settlement.

Statement of a Typical Settler's Experience in the Purchase and Development of a Durham farm, as Shown in the Record of Expenses and Income of Richard Roe in the Durham State Land Settlement.

Contract of purchase signed June 15, 1918. Date of actual settlement June 15, 1918; 70.32 acres at \$165 per acre, total \$11,602.80; 56 acres sown to barley by the board before settlement at a cost of \$816.

*Assets at time of settlement.*

Cash .....	\$275 00
Livestock .....	920 00
Farming equipment .....	300 00
Household goods .....	400 00
Land adjacent .....	1,800 00
	<hr/>
	\$3,695 00

*Operating account to December 31, 1918.*

EXPENSE.		INCOME.	
Deposit on land .....	\$603 76	Original cash .....	\$275 00
Purchase of crop .....	816 00	Sale of crop .....	2,600 00
Land payment .....	440 88	Income from labor .....	625 00
Miscellaneous stores .....	20 40	Sale stubble .....	80 00
Harvesting expense .....	168 00		
Sacks .....	270 00		
Living expense .....	350 00		
Doctor bills .....	75 00		
Fire insurance .....	11 00		
Seed wheat for next year's crop .....	225 00		
Balance cash on hand .....	599 96		
	<hr/>		<hr/>
	\$3,580 00		\$3,580 00

Started next year with \$599.96 in cash and debts paid.

*Operating account to December 31, 1919.*

EXPENSE.		INCOME.	
Building barn .....	\$700 00	Cash on hand .....	\$599 96
Land payment .....	442 55	Sold wheat crop .....	506 00
Taxes for 1918 .....	58 01	Pasture fees .....	30 00
Miscellaneous stores .....	48 59	Sold stock .....	30 00
Fences .....	75 00	Wages .....	1,115 00
House .....	218 00		
State and county taxes, 1919 .....	240 00		
Cash on hand December 31, 1919 .....	498 81		
	<hr/>		<hr/>
	\$2,280 96		\$2,280 96

*Operating account to December 31, 1920.*

EXPENSE.		INCOME.	
Land payment .....	\$467 41	Cash on hand .....	\$498 81
Taxes .....	243 00	Barley crop, 616 sacks at \$1.47½ .....	908 60
Harvesting expense .....	168 00	Pasture .....	40 00
Sacks .....	117 04	Sold stock (beef) .....	77 80
Fence on north boundary .....	52 08	Sold stock (hogs) .....	100 00
Doctor bills (wife's operation; himself broken foot) .....	420 00	Wages .....	677 32
Constructing railroad crossing .....	125 00		
Living expenses .....	525 00		
Miscellaneous farm expense .....	185 00		
	<hr/>		<hr/>
	\$2,302 53		\$2,302 53

*Operating account to December 31, 1921.*

EXPENSE.		INCOME.	
Taxes (delinquent)-----	\$315 00	Cash on hand-----	Nil
Labor-----	50 00	Hay crop (volunteer)-----	\$35 00
Doctor bills-----	60 00	Fed balance to stock (no	
Delinquent doctor bills-----	110 00	income)-----	
Fence-----	44 00	Pasture-----	50 00
Wheat seed for 1922-----	84 00	Sold three horses-----	90 00
Barley seed for 1922-----	35 00	Wages-----	1,310 00
Blacksmith and miscellaneous	26 00		
Miscellaneous farm account--	61 00		
Living expense-----	400 00		
Part land payment-----	300 00		
No cash on hand-----			
	<hr/> \$1,485 00		<hr/> \$1,485 00

Started 1922 without cash, but had 30 acres of wheat and 30 acres of barley not yet harvested. Had to borrow \$600 on freehold land mortgage, 7 per cent, for three years, to take care of personal debts and outside venture of uncertain returns.

*Statement Assets and Liabilities.*

ASSETS.		LIABILITIES.	
Land (state)-----	\$11,602 80	Balance land (state)-----	\$9,577 66
Land (freehold)-----	2,000 00	Mortgage, freehold-----	600 00
Furniture-----	450 00	Due state land payments-----	1,995 41
4 cows-----	200 00	Due state account receivable--	25 91
Plow-----	10 00	Doctor bills-----	180 00
Harrow-----	15 00	Personal debt-----	202 00
Wagon and rack-----	90 00	Expense harvesting (estimated)	180 00
Auto (truck)-----	150 00	Sacks-----	77 00
2 horses-----	200 00	Owing to relative-----	300 00
Estimated wheat crop (300		Net worth-----	2,734 82
sacks at \$1.85)-----	555 00		
Estimated barley crop (400			
sacks)-----	600 00		
	<hr/> \$15,872 80		<hr/> \$15,872 80

His net worth has decreased from \$3,695 to \$2,734, a decrease of \$961 in four years. His position would have been much worse had it not been for the \$2,600 which the crop planted by the Division before the land was offered for sale, brought him.

A producing stand of alfalfa, some good cows and hogs, would do much toward changing this into a successful business venture. When he began grain prices were high, due to the war. The following year barley opened at \$3 per hundred but soon dropped. Its disastrous effect is too well known to be further discussed.

Since that time it has become more apparent each year that grain growing will not pay on the high priced land of irrigation districts.



# STATE DEPARTMENT OF PUBLIC WORKS, DIVISION OF LAND SETTLEMENT, DURHAM, CALIFORNIA.

Balance Sheet as at June 30, 1922.

ASSETS.		LIABILITIES.	
Available cash.....	\$13,502 23	Claims filed (total current liabilities)	\$1,050 39
Land Settlement Fund.....	\$15,926 65	Leland Stanford Junior University	280,487 24
In State Treasury.....	\$5,946 15	Deferred principal.....	\$391,906 35
In transit to State Treasury.....	8,880 50	Interest accrued—not due.....	2,233 28
In First National Bank of Ohio.....	1,000 00		
In Berkeley office.....	200 00		
Administrative Expense Fund—In State Treasury.....	118 95	Less: Advance payments.....	\$304,139 63
Appropriated funds—Chapter 450, 1919.....	556 63	State of California.....	13,632 39
		For expended loan.....	\$244,053 85
		For unexpended loan—in treasury.....	5,946 25
Due on settlers' contracts.....		Total appropriated by Chapter 755, 1917.....	\$250,000 00
For land.....	\$55,182 95	For expended loan.....	\$123,923 86
For improvements.....	1,085 65	For unexpended loan—in treasury.....	556 63
		Total appropriated by Chapter 450, 1919.....	124,480 52
Due on settlers' notes receivable.....	6,735 90	Total appropriated by Chapters 755, 1917, and 450, 1919.....	374,480 52
Due on lease contracts.....	2,014 63	Add: Interest on expended loan—Chapter 755, 1917.....	19,368 51
Miscellaneous accounts receivable.....	7,053 25	Unclaimed equities in properties transferred.....	30 47
		Liability for checks uncalled for.....	118 54
Total current assets.....	\$89,179 64	Liability for special deposits in trust funds.....	351 03
Settlers' contracts—deferred principal.....	585,607 37		
For land.....	\$560,377 94	Total liabilities.....	\$638,454 70
For improvements.....	25,319 43	Reserve for lease contracts.....	1,927 63
		Unexpended appropriation for administrative expenses.....	118 95
Settlers' notes receivable—deferred principal.....	72,980 37	Total liabilities and reserves.....	\$638,501 33
Stores.....	491 76	Surplus—applicable to further development and expense.....	\$142,190 43
Equipment.....	4,687 35		
Farm allotments unsold.....	81,405 25		
Improvements on farm allotments unsold.....	11,172 50		
Cost of crops on allotments unsold.....	214 32		
Reserved lands.....	17,877 46		
Improvements on reserved lands.....	14,880 59		
Lease contracts—preferred rentals.....	1,862 70		
Undistributed service charges—cost of chargeable services.....	381 47		
Trust funds—in Commercial Bank of Durham.....	351 03		
Total assets.....	\$830,691 81	Total liabilities, reserves and surplus.....	\$830,691 81

\*The reserve, amounting to \$142,190.43, will be increased by a part of the \$20,337.77 Berkeley office expense, which is to be allocated between the Durham and Delhi settlements.

**STATE DEPARTMENT OF PUBLIC WORKS, DIVISION OF LAND SETTLEMENT, DURHAM, CALIFORNIA.**

**Statement of Income and Expenditures for the Period June 1, 1917, to June 30, 1922.**

**EXPENDITURES.**

Development-----	\$155,705 34
Soil survey-----	\$268 25
Roads and survey-----	9,554 20
Fences-----	4,822 20
Structures-----	4,840 56
Ditches-----	36,986 73
Pipe lines-----	15,035 50
Irrigation works and culverts-----	43,824 38
Tractor and repairs-----	25,739 18
Rent and repairs trucking equipment-----	6,184 67
Miscellaneous development expense-----	3,686 93
Community park-----	991 00
Operating expense-----	3,829 72
Light and power-----	11 44
Freight and express-----	\$2,120 24
Operation of creamery-----	716 42
Insurance-----	52 50
Operation of irrigation system-----	1,346 50
Depreciation on equipment—actual-----	8,162 35
Repairs to equipment-----	7,969 84
Miscellaneous operating expense-----	59 79
Experimentation-----	4,423 00
Administration expense-----	20 22
Administrative salaries-----	\$31,997 89
Per diem board members-----	829 00
Traveling expense-----	3,392 04
Office expense and supplies-----	4,493 40
Printing and publication of notices-----	2,443 80
Automobile expense-----	3,969 25
Examination of sites-----	794 65
Berkeley office expense-----	
Taxes-----	26,837 77
Interest—Leland Stanford Junior University-----	1,253 62
Interest—State of California-----	62,988 44
Surplus-----	46,227 57
Total expenditures-----	\$367,204 77
Total expenditures and surplus-----	142,190 48
	\$509,395 25

**INCOME.**

From appropriation for administrative expense-----	\$9,831 05
Application fees-----	1,042 00
Amount added to cost of land-----	322,457 89
Amount added to cost of improvements sold-----	3,523 50
Interest on installment contracts-----	118,793 69
Interest on settlers' notes receivable-----	8,501 23
Interest on overdue accounts receivable-----	182 06
Rental of land-----	19,899 81
Pasturage-----	1,751 42
Rental of implements-----	5,337 52
Rental of buildings-----	637 43
Rental of livestock-----	621 79
Irrigation charges-----	10,614 29
Crops-----	4,094 03
Sale of wood-----	46 74
Horseshoeing-----	7 50
Donation of G. H. V. Land Company-----	750 00
Domestic water charges-----	134 40
Rent of way, Pacific Gas and Electric power line-----	590 00
Miscellaneous income-----	318 85

Total income-----

\$509,395 25

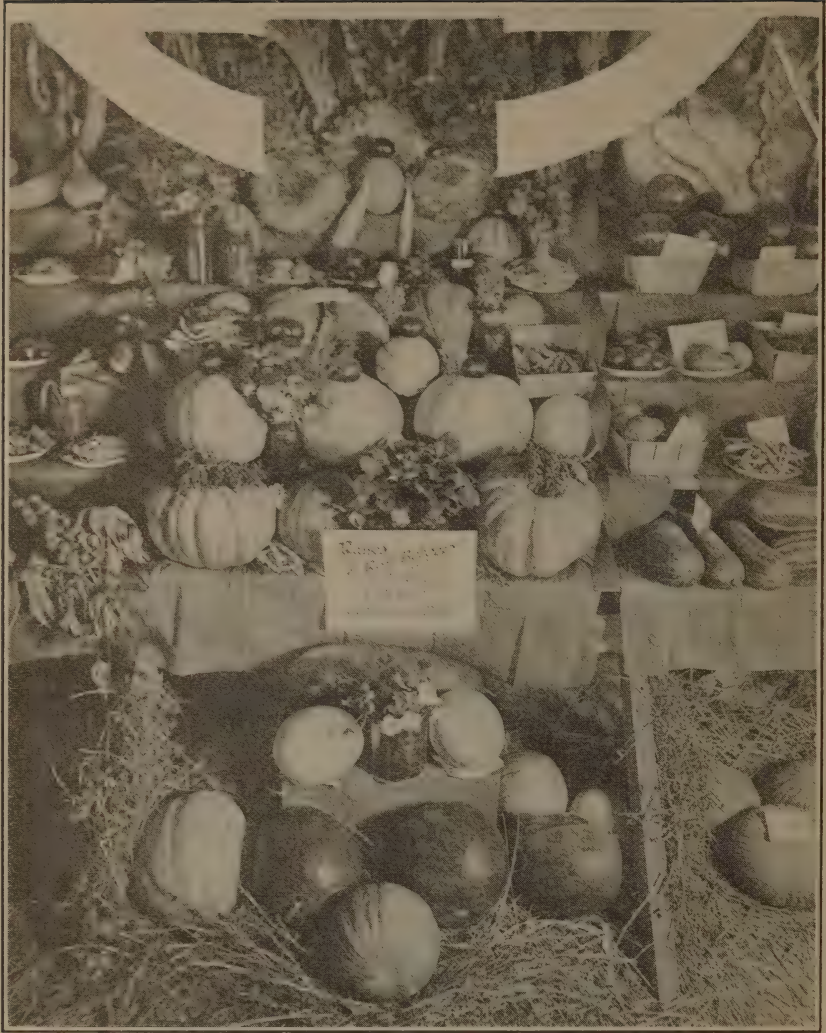


FIGURE 6. Exhibit of Products from Farm Laborer's Allotment, Delhi.



## DEVELOPMENT OF THE DELHI SETTLEMENT.

### Location and General Facts.

The Delhi Settlement is located six miles south of Turlock in Merced County. It includes approximately 8600 acres of land which extends in a body about two miles wide from a mile west of the Southern Pacific Railroad to a point about a mile east of the Santa Fe Railway. Delhi, a station on the Southern Pacific, and Ballico, a station on the Santa Fe, are located on the tract. This tract of land was selected by the State Land Settlement Board in 1920 from eighty tracts of land offered to the board in all parts of the state. Selection was made after careful examination and appraisal of soil and water conditions by representatives of the College of Agriculture of the University of California, the U. S. Department of Agriculture and the State Engineer's office.

### Soil.

The soil is classified as Madera sand, which is well suited to the production of alfalfa, potatoes (particularly sweet potatoes), melons, berries, grapes, nectarines, apricots and peaches. A special soil survey and soil map was made by Professor C. F. Shaw, who is in charge of the soil survey work in the state. It shows the soil conditions to a depth of six feet over the entire area. This map can be examined by intending settlers either at Berkeley or Delhi.

The surface of the land is rolling, with a slope toward the west of about eight feet to the mile. When purchased by the state, a portion



FIGURE 7. Wilson Hall, Delhi.



DELHI STATION S.P. RY.

FIGURE 8. Delhi Station, Southern Pacific Railway.

of the land was planted to grain, the balance being covered by alfalfa, foxtail and bronco grass with occasional fields of poppies, lupin and morning primroses, used generally as sheep feed. Climatic conditions are much the same as in all other parts of the San Joaquin Valley.

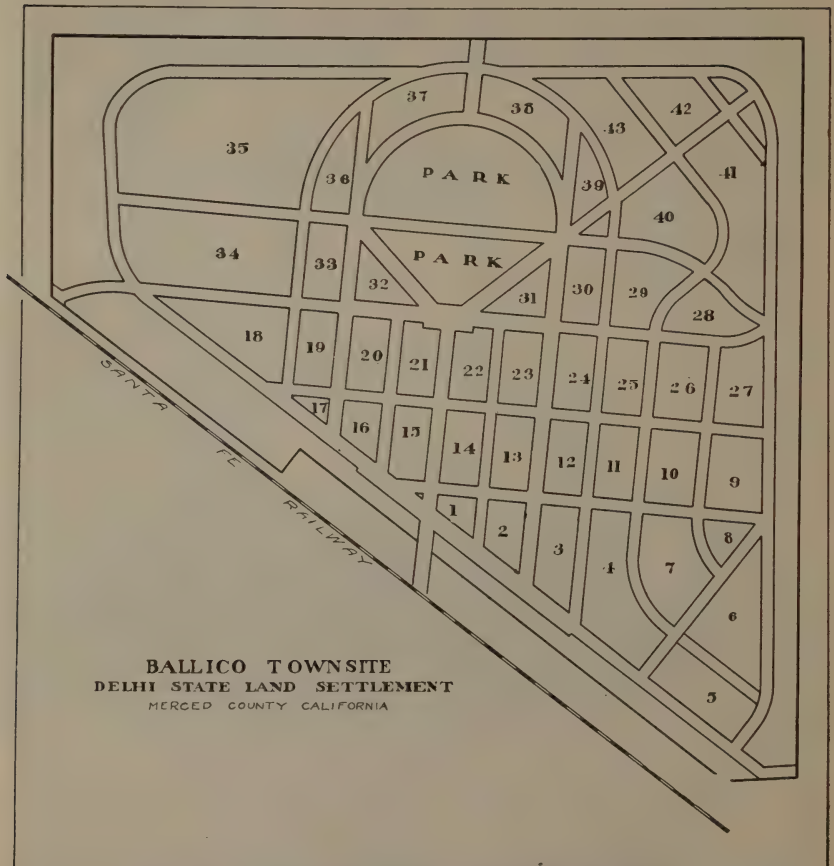


FIGURE 9. Townsite at Ballico on the Delhi Settlement.

### Weather Conditions.

The summer temperature sometimes runs over a hundred degrees, but the nights are invariably cool. The following table gives the records for Merced for the past ten years, the annual rainfall of eleven inches making irrigation necessary:

#### TEMPERATURES AT MERCED, CALIFORNIA.

Highest temperatures:

Length of record	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
15	72	79	86	96	105	109	116	114	110	102	86	75	116
Lowest temperatures:													
15	20	23	25	31	32	40	40	41	35	28	21	16	16
Mean maximum temperature:													
11	56.3	61.5	66.9	73.5	80.4	90.3	97.5	96.3	89.3	81.0	67.2	56.8	76.4
Mean minimum temperature:													
11	35.5	37.9	41.2	44.1	48.5	52.3	60.5	58.1	53.0	45.9	38.7	34.0	45.8
Mean temperature:													
38	47.0	51.0	55.0	60.0	67.3	75.3	81.7	79.3	73.7	64.8	55.4	48.3	63.2

#### PRECIPITATION AT MERCED, CALIFORNIA.

Annual Reports Since 1872—Monthly, Seasonal, Average Amounts.

(In inches and hundredths.)

Means:	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Seasonal	Annual
	0.01	0.02	0.21	0.49	1.17	1.59	2.35	1.48	1.89	0.95	0.54	0.12	10.82	10.82

### Irrigation Supply.

The land is a part of the Turlock Irrigation District, the oldest district in the state. The water right of the district is not only the first on the Tuolumne River, but is guaranteed by a congressional grant. A continuous head of water is diverted from the high line canal of the district to the main pipe lines belonging to the settlement. The allotments are divided into nine zones with a separate rotation for each zone. Each rotation is so arranged as to allow for a complete irrigation of each allotment within the rotation period. The settlers pay a portion of the cost of distributing the water through the pipe line in addition to the irrigation district tax.

### Domestic Water Supply.

Domestic water is secured from wells on each allotment. Some use two-inch hydraulic wells which cost from \$35 to \$50, although the majority favor seven-inch cased wells. Many pump water by hand, some use windmills, some gas engines or electric motors in connection with overhead tank or underground pressure system.

### Land Purchase.

The land was purchased in the fall of 1919. The first unit, comprising forty-nine farms and twenty-six farm laborers' allotments, was offered for sale at the first opening in May, 1920. The second unit was opened in September, 1920, and the third unit in January, 1921. The fourth and last unit will be opened in November, 1922.



## Settlers.

Two hundred and twenty settlers have secured allotments at Delhi. Seventeen, or 8 per cent of this number, have left; 85 per cent sold their allotments for the full value of payments and improvements. This record in itself indicates sound progress. Of the 205 settlers now on the land, 109 settlers hold farms averaging 28 acres in size but ranging from ten to 175 acres, which is 77 per cent of the farms so far offered for sale; 43 hold poultry farms, ranging in size from 3.5 to 10 acres, equaling 73 per cent of all poultry farms offered for sale. Fifty-three hold 2-acre farm laborer allotments, or 90 per cent of the total number of laborers' allotments offered for sale.

Five thousand six hundred and forty acres of land have been offered for sale: 4174 acres, or 74 per cent, have been sold.

Eighty-two per cent of the settlers at Delhi are from California, the balance are from fifteen different states, from Canada, Australia and England. *About one-half of the total number are veterans of the United States Army.* The average age of the settlers is 40 years; the average capital is \$3,251. The total population of the settlement, excluding those who do not own land, is 550. Although all settlers have had some farm experience, many have made their living at various times from some trade other than agriculture. An incomplete census shows a representation from the following trades and professions:

Teachers—	Salesmen—	Miscellaneous—
High school	Auto	Aviator
Grades	Real estate	Hand-coloring photographer
Kindergarten	Traveling	African guide and big game hunter
Piano	Professions—	Band leader
Stringed instruments	Physician	Florist
Elocution	Osteopath	Orchestra players
Æsthetic dancing	Trained nurse	Radio operator
Engineers	Photographer	Movie machine operator
Civil	Banker	Farm adviser
Electrical	Storekeeper	Shipbuilder
Irrigation	Minister	Sailor
Railway locomotive	Trades—	Milliner
	Baker	Dressmaker
	Gardener	Rug weaver
	Plumber	Land appraiser for Federal Bank
	Electrician	Street car conductor
	Plasterer	Policeman
	Sign painter	Cheesemaker
	Bookkeeper	Shoemaker
	Telegrapher	Mechanic, auto
	Carpenter	House painter
		Stenographer
		Fireman

## Financial Returns.

Before the land was sold to the state, the annual return from rental for grain and sheep pasture amounted to about 50 cents an acre, or \$4,000. The income to the settlers for 1922, from but one-half of the total acreage bought by the state, is estimated at \$75,000. It is estimated that the value of the fruit alone, from the orchards now planted and to be planted in the immediate future, will be approximately \$1,000,000 a year. Certainly within six years from the time the first settler planted his first crop, the land will be producing close to a million dollars worth of wealth a year, as against an original rental value of \$4,000.

### Crops.

Records in June, 1922, show 1369 acres in alfalfa, 347 acres in trees, 343 acres in vines, 100 acres in sweet potatoes; the balance being in corn, sudan grass, melons, or is still unimproved and not cropped.

### Dairying.

The dairy industry has received first attention not only because the returns are more immediate than the return from fruit but also because the return is steady and assured. The development of a desirable type of dairy herd has been assured through the cooperation of the Dairy Division of the U. S. Department of Agriculture in the employment of Mr. C. V. Castle, a dairyman by profession and training. Mr. Castle resigned the position as head cow tester for the Western States to accept the appointment at Delhi. He has helped in the selection of cows, in the care, feed and management of the various herds, has organized a cow testing association and has conducted the testing. The settlement now includes 211 grade cows valued at \$25,320; 48 grade heifers valued at \$1,200; 32 purebred cows valued at \$11,200; 13 purebred heifers valued at \$1,950; 16 purebred bull calves valued at \$1,600. One of these calves has been sold to a Holstein breeder for \$200.

The average production of the cows has been satisfactory. The cows tested have topped the list of cow testing associations in California given in the Monthly News Letter of the Department of Agriculture for five months out of the seven months that records have been kept. For three months the average production per cow per month has exceeded 40 pounds. Several of the registered cows are on official test.

A bull association has been organized with three subblocks, each block handling one of the bulls owned by this association. De Kol



FIGURE 10. Holsteins in Barnyard of a Delhi Settler.

Pontiac Patti, purchased for \$864 from the Stanislaus County Holstein Breeders' Association, was the first bull secured. He was loaned to the dairymen of the settlement for a year and at the end of that time was taken over. This bull is out of Black Patti with a 914-pound record. He was sired by Segis Pontiac De Kol Dutch with 10 A. R. O. daughters. Four nearest dams of this bull average 1008 pounds of butter.

Aaggie Colantha Moreland is an aged bull bought from a purebred breeder of Denair who was retiring from active dairying. This bull was sired by Colantha Sir Pontiac Aaggie with 30 A. R. O. daughters, one with a record of 35.03 pounds of butter in seven days and another with 32.87 pounds of butter in seven days. Sir Ormsby Akkrummer Korndyke was purchased from John B. Irwin of Minneapolis. This bull combines some of the greatest blood of the breed, through Miss Korndyke Akkrummer Ormsby to Hengerveld De Kol and through Sir Ormsby Banastine Champion to Duchess Skylark Ormsby, the world record cow with 1606 pounds of butter in a year. This sire is the youngest son of Pietertje Maid Ormsby, for which the owner refused \$40,000.

The Holstein breed has been selected as the breed for the settlement. No tubercular cows have been purchased and all cows are tested every six months and all reactors are eliminated.

REPORT OF DELHI COW TESTING ASSOCIATION, JULY, 1922.

Name of cow owner	Number of cows	Average fat
R. F. Kretz.....	6	41.4
A. M. Widener.....	11	37.1
O. G. Stoops.....	8	47.3
E. A. Nelson.....	2	48.0
O. A. Hill.....	8	41.0
C. V. Castle.....	1	49.6
Geo. Pope.....	3	48.3
Frank Bray.....	8	45.0
R. Dougherty.....	6	33.9
Geo. Jones.....	8	27.0
L. E. Dickover.....	6	40.5
R. E. Schippmann.....	11	35.3
F. B. Davies.....	5	43.6
Fenley Robinson.....	13	36.2
R. S. Hull.....	2	50.8
D. C. Peters.....	9	40.7
Mrs. Mae Lee.....	6	44.0
W. G. Bailey.....	2	43.4

Alfalfa.

Alfalfa is the foundation of the dairy business in Delhi. The land is irrigated by the border method, the lands varying from 20 to 30 feet in width and from 250 to 500 feet in length. The 25-foot lands, 250 feet long, are most satisfactory. It costs from \$15 to \$35 per acre to prepare the land for the border method of irrigation, \$22 being a fair average charge. Alfalfa is planted in September and October if the land can be irrigated before seeding; otherwise, any time from November 15 to March 1. Nurse crops are not generally used. The fields are usually



covered with straw, manure or corn stalks to prevent damage by wind in the early spring. Rye is often sowed on the borders as a wind protection. Three or four hundred pounds of gypsum to the acre, or 100 pounds of sulfur and 300 pounds of lime to the acre, increases yields and has proven profitable. The gypsum is usually applied each year, while the lime and sulfur will last for four or five years. When fertilizers are used, from one to two tons are secured at each cutting. Five cuttings are secured regularly, while six and seven cuttings are not infrequent.

#### **Fruit.**

The production of fruit, especially peaches and raisin grapes, will ultimately be the most important industry in the settlement. The soil is well adapted to the production of good peaches. It costs from \$8 to \$20 per acre to prepare the land for planting; \$15 would be a fair average. Cling peaches dominate, although some free stones have been planted. Varieties so far include: Phillips, Tuscans, Palora, Peaks, J. H. Hale, Elberta and Lovell.

Thompson seedless and Malaga vines are the two varieties of grapes planted so far. Cuttings of a new seedless grape known as the Black Monukka and cuttings of the Red Malaga have been planted this year and will probably be planted extensively. Commercial fertilizers are not used now on trees and vines, although fertilizing trials are being made in demonstration orchards. Cover crops are being tried out and will probably be grown extensively in the near future.

The production of fruit is essentially a community enterprise. The problems of buying and planting trees, of pruning and care, are con-



FIGURE 11. Two-Year-Old Thompson Seedless Grapes on a Delhi Allotment.

sidered not only as individual problems but as necessary to the best interest of the entire settlement. Good healthy trees are possibly more important than good healthy cows on account of their permanence.

#### **Truck Crops.**

Sweet potatoes have proved to be the most satisfactory cash crop. The soil is well suited to the production of very fine quality potatoes. Eastern seed was purchased from New Jersey by the settlers in the spring of 1922. Careful selection in the field is to be practiced so that the production of quality potatoes can be increased. Although melons do well in Delhi, the market conditions do not warrant extensive planting. Settlers are advised to go into melons on a very small scale, if at all. Cucumbers, summer squash, egg plant, lettuce, etc., do well and commercial plantings are being tried.

#### **Poultry.**

The poultry industry is growing rapidly. Not only are there a number of poultry specialists but nearly every settler has a farm flock of considerable size. There is a total of 20,000 hens in the settlement, with about a mile of poultry houses with capacity for 30,000 when fully stocked. This is just a beginning. The soil is a distinct advantage to the poultrymen. Alfalfa forms the basis for green feed, although other green feed is raised. As Delhi is in the center of a grain area, scratch feed can be mixed by settlers to advantage. White Leghorns are most commonly raised, although Rhode Island Reds and Plymouth Rocks are raised by some. The poultry farms range from 3.5 to 10 acres. Two or three acres are planted to alfalfa for poultry and cow feed. The balance of the land is usually planted to trees which fit in very nicely with the poultry development.

#### **Marketing.**

Marketing is carried on very largely through existing cooperative associations. The grape growers have joined the Associated Raisin Company. The dairymen belong to the Milk Producers Association of Central California. The peach growers have joined the Peach Growers Association. The poultrymen ship to the Poultry Producers of Central California and the sweet potato men ship through the Sweet Potato Growers' Association. The problem of marketing staple products is too large for a community to handle as a community enterprise.

#### **Cooperative Buying.**

Buying is rather extensive in a new settlement. In 1922, \$23,000 worth of supplies were purchased cooperatively. This included trees, vines, fertilizers, manure, brooder stoves, coal, posts, fencing wire and trellising wire, alfalfa seed, hay, tree protectors and sweet potato seed. Implements were purchased in 1921. There was a saving in the price in all cases. Coal, for example, was delivered to the homes for \$17.50 per ton as against a price of \$20 in town undelivered. The main benefit shown was in the service rendered. Instead of having each settler go over the country looking for sweet potato seed and bidding against his neighbor for the supply, the seed was purchased by a committee appointed by the settlers. In the purchase of trees and vines care was

taken in the selection of the stock and in protection from disease and insect enemies. Due to the fact that orders were put in very late, it was impossible in many cases to get the trees desired and as a result the stand is not satisfactory in several cases. All vines were purchased from areas where phylloxera and nematode do not exist and as an additional protection all vines were treated before being brought into the settlement. In the future, the buying of trees and vines will be



FIGURE 12. Poultry House on Delhi Settlement.

carried out by settlers acting as regularly appointed agents of nurseries approved by the settlers association. This arrangement assures better care with the trees than is possible under the system previously followed.

#### **Assistance Given to Settlers.**

Advice and help was given to the settlers in various ways by the Division of Land Settlement. The help given on building programs and farmstead layouts is given elsewhere. Practically all of the land leveled in the settlement has been done under the direction of engineers employed by the state. The original layouts were first agreed upon by the settler and the superintendent. Bids were then secured on the work if it were to be done by contract, and the job was let to the lowest bidder provided he was able to do the work satisfactorily. Specifications were drawn up which were signed by both the contractor and the settler. Payment was usually made through the state, although contracts were not signed by any state representative. Whenever a settler could do his own leveling he was urged to do so. This work was planned and supervised in the same way as though a contract were let. A charge was made for actual time spent by the survey parties in



the field. No charge was made for topographical maps giving elevation to a foot contour for suggested layout, or for time spent by the superintendent in planning the layouts, drawing contracts or supervising and accepting the work. The cooperative buying was conducted through the Delhi office of the Division. The problem of variety was taken up through the cooperative association with individual settlers. Orchards and vineyards were often staked out by men employed by the state but paid by the settlers. In practically all cases orchards and vineyards were properly oriented by the engineering field crew. Meetings were held to discuss important agricultural problems and outside speakers were secured when necessary.

The help of professors from the State University has been continuous and of great value. Three field demonstrations on vineyard care were conducted by Professor Bioletti of the University of California, at which time practically every vineyard in the settlement was visited. Mr. Quail, assistant farm adviser, held one field demonstration on the planting, care and pruning of young trees. Professor Phelp spent three days in the settlement visiting each orchardist and going over individual problems of care and pruning. Professor Whitten spent some time in the settlement studying the problem of fruit varieties and later gave his advice in a long and carefully studied letter. A synopsis on sweet potato culture was prepared by Professor Carey for the Delhi settlers. This was used in connection with a field demonstration in starting off on sweet potato culture.

Two dairy trips through Stanislaus County, a poultry trip to the Rio Linda Colony at Sacramento, another to poultry establishments near Modesto and another to Petaluma were carried through during the year. Professor Dougherty spent a day in visiting the various poultry farms and in advising the poultrymen regarding their problems. He spoke on poultry feeding at an evening meeting of settlers.

Mr. Castle keeps in daily touch with the dairymen, advising them on all phases of their work. His advice and help has been invaluable.

Professor De Ong of the University of California made a special trip to Delhi to advise about the control of army worms. One of the allotments was used as a demonstration and various methods were used. Individual farms were visited whenever any damage from army worms was reported and every relief measure known was employed with satisfactory results.

#### **Delhi News.**

In addition to very numerous farm calls, office consultation and letters, information and advice was given through a mimeographed paper called the "Delhi News." This paper is put out weekly and the effort is to incorporate in each issue important and timely agricultural problems of a local nature. When sweet potatoes are to be planted, the various steps are followed through in detail. When alfalfa fields should be covered not only is the matter brought up repeatedly, but in many cases the state actually performs the work at the request of the settler on account of a rush, the cost of the work being charged to the settler. All notices of meetings, social events, new arrivals, etc., appear in the paper.

### **Experiment Farm.**

The University of California has established a forty-acre experimental farm, largely for working out irrigation problems relating to the type of soil found in the settlement which is a representation of a large area in the state. This farm is planted to alfalfa, trees and vines and serves as a demonstration of varieties and methods as well as serving as an experimental field for scientific research.

### **Veteran Welfare Board.**

The Division of Land Settlement is cooperating with the U. S. Veteran Welfare Board in training men in agriculture, who have received some disability during the war. Twenty-one men are now on the list, twelve of these men are on the settlement and nine reside within a short radius of it.

Each man is visited once a week by a federal training officer employed by the Division of Land Settlement, and given personal help in working out his program. Each man has been located on a home project which he expects to develop into profitable agricultural enterprise, with dairying, poultry raising, fruit culture or general diversified farming as objectives.

Those who buy land are first asked to make out a careful budget showing just what is to be done with the money received from the government as a monthly allowance. This budget usually runs for a period of at least two years. It is usually made out with the help of the training officer and the superintendent and with data furnished by the Division of Land Settlement. This program is adhered to as closely as possible both in handling the money received from the government and the money loaned by the state on improvements. A certain stipulated sum is allowed for living expenses, the balance is put into improvements. Before a trainee is accepted as a settler he must have an assurance of two years training by the government if he has \$1,000 or more in cash, or three years training in case he has no cash on hand. With this help any industrious man should be able to meet his obligations and develop a profitable farm within the time allotted.

The Land Settlement Act of California provides for loans to settlers not to exceed \$3,000 to any one individual. No money is advanced to any settler until his own money has been spent on development. The state can then advance 60 per cent of the value of the improvements, the money to be spent in further development.

So far \$145,961.79 have been passed in loans to 133 settlers. This is outside of loans on pipe lines aggregating \$175,000 more. The largest individual loan is \$1,511.92, the smallest \$25.50. The largest amount loaned to one settler has been \$2,519.

### **Social Life.**

The social life of the Delhi Settlement centers about Wilson Hall, a \$10,000 community center, made possible through the donation of \$5,000 by Edgar M. Wilson of San Francisco. The spirit which Wilson Hall embodies is expressed in a bronze tablet in the entrance

hall which carries an inscription written by ex-President Benjamin Ide Wheeler of the University of California:

"Wilson Hall typifies the neighborhood spirit wherein men are social beings rather than machines, dwell in homes not laboratories, and lead the old Town Meeting out into the service of the new economic democracy.

"From the beginnings of human civilization, the irrigation trench, in Egypt and Babylonia, taught men to work together. Today history is written in terms of such works as the hospital, the library, the church and the schools. Joint credit, security of life, and community health have laid the basis of a cooperation, rich in sympathy and keen to serve. For what is a man profited, if he shall gain the whole world and lose his own soul?"

Here the community meets to transact community business, to meet in a social way at dances, parties, socials, plays, lectures, etc., and to conduct religious services. The hall was dedicated on September 29, 1921, by Wm. D. Stephens, Governor of California, under whose administration the Land Settlement Act was passed. A tour over the settlement occupied the afternoon. A barbecue was served in unique style from the overhead carriers at the pipe shed for supper. The city of Merced, the county seat, closed its doors for the occasion. Bands were brought from Merced and Turlock for the occasion, which proved to be a memorable one.

#### **BUILDING AND FARMSTEAD ENGINEERING.**

##### **Activities.**

The activities of this department embrace not only planning, designing, quantity surveying, obtaining competitive bids, letting contracts, and supervising construction of all classes of farm, townsite and administrative buildings, but include also making individual farmstead layouts for all settlers, determining location and arrangement of buildings, lanes, corrals, poultry runs, domestic wells, orchards, vegetable gardens, etc. Individual settlers are acquainted with health recommendations relative to sewage disposal, protection of domestic water supply, insurance rates and hazards, requirements of good practice in plumbing, electric wiring, paint formulas, concrete mixing, chimney construction, carpentry, etc. Buildings are appraised and values set as basis for loans, and buildings rented are scheduled by this department.

Active interest and support are given to community development, services being extended to school board and Settlers' Cooperative Association. This included designing and supervising construction of the Community Hall at Delhi recently completed.

##### **Objects of Service.**

Through this department the settlers' time has been conserved and better buildings have been built at less cost than would have been possible had each farmer been obliged to make repeated trips to town for materials and assistance.

It has been demonstrated beyond question that when buildings are properly designed, planned and built to meet individual requirements,



contentment and success are more liable to follow than in cases where no organized effort is at work.

Loans made by the state are more securely protected and appraisals of building improvements are more accurately made with costs and building data amassed by this department as a basis.

#### Operation Methods.

In cases where a settler is more or less of a mechanic, and is in a position to do his own building, he is advised to do so. In all other cases the contract system has proven most satisfactory. In either case a complete set of plans is furnished.



FIGURE 13. Alfalfa and Buildings on Farm Allotment, Delhi.

Under the contract system a set of specifications is drawn, and after the plans and specifications have been approved by the settler, the work is advertised for bids in the open market in accordance with regulation practice. Sealed bids are received and opened at a predetermined hour in the settler's presence. If accepted, and upon receipt of authorization with accompanying deposit by the settler, a contract is entered into between the state and contractor, and work proceeds under the supervision of the farmstead engineer, acting as agent of settler until completion and acceptance. The contractor's accounts are audited and the full responsibility is removed from the settler until he accepts the work as complete and satisfactory to him. This service is a complete architectural professional service. The contractor is responsible for accident to his workmen or the public, for loss by fire, and is under bond for faithful performance of the contract.

Where a settler is able to do his own building work, a quantity survey of the materials required is made, and competitive bids taken on these materials in the same way that bids are taken on labor and material contracts. The settler is furnished a copy of the material list to serve as a guide, the list giving instructions for the cutting and placing of various items thereon.

Wherever it has been possible to purchase building materials in car-load or large quantities by grouping orders, this has been done to give the settler the benefit of the state's purchasing power.

By a careful system of checking contractors' accounts, and by requiring detailed statements from settlers before loans are made, labor and materialmen are given positive protection, saving them collection costs and making their business through the state very desirable. This is an important factor in keeping down costs.

Our well established contract system with its uniform and well known methods of procedure has earned the confidence of local contractors and has created a wide and keen competition.

#### **Extent and Cost of Buildings to Date.**

The first building contract was awarded March 4, 1920.

Today there are 454 buildings on the settlement, having been erected at the rate of a building every 1.5 working days.

Three hundred thirty-nine are farm buildings on 132 farms at a cost of \$177,749, including domestic wells, or \$1,346 average per farm.

There are 86 buildings on 51 farm laborers' blocks at a cost of \$51,788, including domestic wells, or an average of \$1,116 per farm laborer's block. There are 26 administration buildings representing a cost of approximately \$85,000.

The Wilson Community Hall cost \$10,000.

The total value of all buildings on the settlement, including domestic wells, amounts to \$325,000.

Over \$170,000 of this amount was spent under contract. There was produced by settlers' labor \$81,000 from plans furnished by use. There has been spent \$72,000 following settlers' plans, but with construction supervised by this department.

Ten per cent is a conservative estimate of the cost saved by this department in letting the work under contract. Still greater saving is effected through the intelligent planning of buildings and by the utilization of the most suitable materials and of standard sizes that avoid waste.

Where special plans have to be prepared a charge of 3 per cent of the value of the work is made by the Land Settlement Division. Where stock plans are usable the charge is 2 per cent, which has made this department self supporting, considering its contribution to general administration. It has also produced administration buildings at 3 per cent of their cost.

#### **Dwellings.**

As in the case of all other buildings, the determination of the amount to be expended and the type of each dwelling to be erected is based on a personal interview with the individual settler and a thorough knowledge of his requirements. There are three distinct ways of commencing

the dwelling program, requiring earnest consideration. A dwelling may be designed with only the ultimate needs in mind, and more or less without regard to cost, being so planned that it may be built in units within reach of available cash.

The shell or skeleton of the dwelling may be built with a view to completing it in installments during winter months and odd times or as capital permits, or a temporary dwelling of a type suitable for converting to some utility use may prove most satisfactory. The latter type is the cheapest, for all of the material within it peculiar to a dwelling may be salvaged for later use in a permanent structure, leaving a higher type of utility building than perhaps could have been afforded otherwise. The complete unit costs the most for a corresponding amount of space, for the reason that it is built with permanency in view.

Personal characteristics of the occupants play an important part in determining which path to follow. The "temporary" dwelling must not become permanent, the shell is not satisfactory unless completed and new units should follow with increases in the family and expansion.

#### **Poultry Housing.**

The type of poultry house adopted at Delhi as a standard is the University of California recommendation with a shingle roof and other minor exceptions.

There is on the settlement today poultry housing capacity for 30,000 laying hens. If built end to end the housing would be a mile long.

Over 23,000 of the total capacity is in the standard house at a cost of \$22,120, or 95 cents per hen.

Remaining poultry houses are of various designs at a cost of \$7,862, or \$1.18 per hen.

#### **Other Buildings.**

The California type of barn with central hay storage and with wings at either side is the most economical type, and lends itself very well to erection on the unit system. Barns are located with relation to other buildings so that grade "A" dairies are possible. The smaller barns are designed so that it is possible at a later date to convert into general purpose buildings such as are more suitable to an orchard or vineyard development. Plans are under way for the erection of the first silo, which will be of the Farm Bureau wood hoop type.

#### **Domestic Wells.**

There are 84 1½-inch and 2-inch hydraulic wells and 62 7-inch cased wells on the settlement. The 7-inch cased well is recommended for domestic supply and the average depth of such wells on the settlement is 66 feet with 55 feet of casing at an average cost of \$108. The water stands in the wells at depths varying in the settlement from 14 feet to 25 feet with a limited few of a greater depth and an average of approximately 18 feet.

#### **Loans.**

Loans to settlers on buildings are based on itemized statements of cost and bills, and receipts produced by the settler, checked against current costs and backed by personal inspection and appraisal.



There has been loaned on buildings and wells \$95,000, over \$70,000 of which has been certified on 171 separate certifications of inspection and analysis, the remainder on 49 separate improvement and construction contracts.

#### ENGINEER'S PROGRESS REPORT FOR YEARS 1921-1922.

Within the past two years, 4174 acres of land in the first, second and third units have been provided with main and lateral concrete pipes for irrigation, while main pipe lines have been installed to serve 6000 acres. Mr. M. B. Williams, formerly chief engineer of the project, designed the entire system. He advocated concrete pipe because of the undulating character of the ground surface and the impossibility of reaching high areas with open ditches. Concrete pipe has many other advantages, however, namely:

1. Saving of water in transit that would otherwise be lost in seepage and evaporation.
2. Reduces land leveling to a minimum.
3. Saves land that would be used for ditches.
4. Facilitates the passage of farm implements.
5. Delivers water under pressure, reducing cost of farmers' laterals.
6. Reduces maintenance of irrigation system.
7. Greater convenience in irrigating, resulting in saving of labor.
8. Minimizes drainage troubles in light soils.

Concrete pipe mains to serve farmers' laterals extend throughout the whole colony. These mains have their intake at several points along the high line canal of the Turlock Irrigation District and from wells.

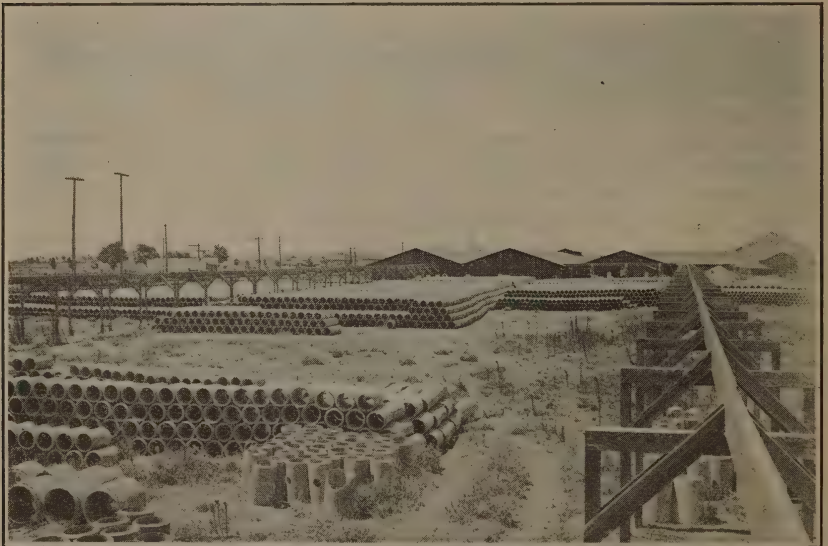


FIGURE 14. Tile Yard, Delhi Settlement.

In the design of the first and second units it was assumed that 90 per cent of the total acreage under the system might be irrigated during any one month, also that one-half of this acreage might be in alfalfa with a monthly requirement of eight inches per acre, and the other half might be in orchard, vineyard or field crops with a requirement of six inches per acre per month. In the third unit the total area was divided into several zones, each to be supplied by a separate main. The requirement of each zone was computed separately on the basis of six inches per acre every twenty-one days over the whole area of the zone. Starting at the extreme end of the zone, the proper size was determined to deliver the required amount of water starting with small pipe and increasing in size toward the intake. Sizes of mains were determined by Table No. 6, Bulletin No. 852, on the "Flow of Water in Concrete Pipe," by F. C. Scobey, U. S. Department of Agriculture, and range in size from fourteen to thirty inches. Areas of approximately the same elevation were placed in separate zones so that excessive strains would be avoided in passing from high to low ground.

In general, the mains were reinforced through swails for heads exceeding twenty feet. Reinforced bands around the pipe, consisting of a strip of three-fourths inch square mesh ten inches wide, imbedded in the joint mortar, were placed every twenty feet to prevent crack runs in case of rupture of the pipe through water hammer. On some mains the additional precaution was taken of pouring a block of concrete around the pipe every 200 feet to guard against possible runs. Air valves or vents were placed on all high points to permit escape of entrapped air which might reduce the carrying capacity. Before any pipe was laid, the subgrade was carefully checked by a level crew to avoid air pockets. Overflow spills were provided on all mains usually returning the excess water to the canals. Open surges ranging in size from 30-inch concrete pipe to 8-inch sheet metal pipe were provided to protect the pipe against impact.

Wherever possible, main lines parallel public highways, which greatly facilitates the distribution of water as well as repair work.

Farmers' laterals range in size from 8-inch to 14-inch. In a very few cases 6-inch and 16-inch pipe were used. For a flow of two second-feet, the prevailing alfalfa head, a 12-inch or 14-inch is most commonly used. For orchards, vineyards and field crops 10-inch pipe has been generally used. Nos. 8 and 10 orchard valves with stands containing two 4-inch galvanized iron distributing gates with tubes are working very satisfactorily for orchard and vineyard irrigation. It is probable that stands will ultimately be placed at the head of every row of trees and every other row of vines. Ten and 12-inch alfalfa valves, placed at the head of every other border, or fifty feet apart, has been the usual practice on alfalfa irrigation.

#### **Pumping Plants.**

Twelve electric pumping plants have been installed. Their capacity ranges from  $2\frac{1}{4}$  to 10 cubic feet per second. Five of them boost water from the high line canal to lands that are above it. Seven pump water from wells into the pipe lines. Another  $3\frac{1}{2}$  second-foot double suction centrifugal pump lifts water from the Merced River to four farms not connected with the main system.

The purpose of the wells is to supply water for trees and gardens after the gravity supply in the canals runs out, but they are serving another useful purpose in helping to maintain a low water table. The wells are principally of a 12-inch bore, ranging in depth from 80 to 200 feet, with an average of 125 feet. The water level is now held and the distance to it varies with the elevation of the ground surface, ranging from 42 feet as an average on the eastern third to less than 20 feet on the western third. The draw-down of wells during continued pumping varies from 13 to 30 feet. The lifts range from 15 to 27 feet. All of the electric pumps are mounted on substantial concrete bases and are covered by sheet metal houses. Sand traps, consisting of 10 feet of 30-inch pipe laid horizontally with a flushing gate, were installed underground at all wells.

### Structures.

All structures have been made of concrete. Two hundred and twenty diversion chambers have been installed which include canal intakes and diversion chambers for farmers' laterals off the concrete mains. The latter consist of sealed gates, capped stands and open pipe surges containing shut-off gates. The sealed gate chamber and the capped stand were both developed by engineers of the Delhi Settlement. The sealed gate chamber is best adapted to diverting water from a main in more than one direction. The objective aimed at was to divert water under pressure from the ground surface without ascending a tall surge to reach the gate handles. It consists of a square concrete chamber capped with a  $\frac{1}{4}$ -inch steel boiler plate which is drawn down firmly against a flax gasket by bronze bolts. The stuffing boxes for the gate handles are acetylene welded to the cover. The chamber is placed in the ground so that the cover is flush with the ground surface. This structure was at first poured in place but it was later found more economical and satisfactory to construct the complete unit in the pipe yard.

As the sealed gate chamber was rather expensive for a one-way shut-off, a capped stand made of concrete pipe was developed. They are used to divert water from a main line as well as for shut-off gates in a large system.

The capped stand consists of concrete pipe for a gate chamber with another one-half joint of pipe closed at the top for a cover. A  $\frac{5}{8}$ -inch square flax gasket between the cover and the lower pipe containing the gate prevents escape of water. The pipe cover is held in place by four  $\frac{5}{8}$ -inch galvanized steel rods on the outside of the stand which are anchored in the concrete base. A cast iron spider imbedded in the cover with extensions over the sides receives the four rods. The stuffing box for the gate handle is in this case imbedded in concrete cover. The spiders, stuffing boxes and rods were all made of an original design. Before installing these structures, tests were made in the yard until the desired strength was obtained. Over 100 of these shut-off gate structures were installed last year.

Three Collins flow indicators were set in main lines at the main intake on the High Line Canal for the purpose of proportioning divided heads and measuring the flow of water. They read direct in gallons per minute.



No attempt has been made to measure water at the individual farmer's intake. In all probability this will never be necessary with the abundant supply of water available from the Don Pedro Dam.

#### **Surveys.**

A topographical survey of the entire colony was made in 1919 and 1920 by J. R. Jahn. By using a rod with a logarithmic scale of his own design, it was possible to take unusually long sights accurately. Points 2000 feet from the instrument were frequently read. From one set-up 160 acres could be taken. Four men frequently took topography on 160 acres in one day, taking 1100 to 1300 sights. The topographical maps on a scale one inch to 100 feet were used as a basis for subdivision and the design of the pipe system.

Rather than divide the settlement into arbitrary rectangular units of 10, 20, 30 or 40 acres, regardless of their ability to be irrigated, it was subdivided so that each farm could be irrigated to the best advantage with a minimum amount of pipe. Wherever possible property lines follow the swales. Where two men irrigate toward a common depression, each has the incentive to guard against flooding the low ground. The corners are being marked with permanent concrete monuments to avoid later disputes.

#### **Farm Layouts.**

Blue prints of each allotment on a scale of one inch equals 100 feet were made, showing the proposed pipe system. These maps have been distributed to each settler free of charge.

#### **Leveling Contracts.**

Two men were employed through the leveling season to assist the settler in securing land leveling contracts and later to check the work of the contractor. The settler was billed for part of this service.

#### **Pipe Manufacture.**

Approximately \$41,000 were expended in constructing and equipping the Delhi concrete pipe factory. The fact that the pipe factory can be operated either day or night twelve months in the year and the low operating cost due to labor saving equipment have justified this expense. Without adequate shed space, it would be impossible to manufacture a quality product in the blazing summer sun or in freezing nights of the winter. Like wise, it would have been impossible to turn out the quantity of pipe needed to complete the irrigation system in time to water the farms already sold and settled in the first, second and third units without a factory of sufficient capacity.

The factory is located on one of the Delhi railroad spurs. Practically all materials are shipped in. There is bunker space for ten carloads of materials. The mixers are placed close to the material piles so that no rehandling of material is necessary. The smaller sizes, 6-inch to 16-inch, are made with a Brubaker packerhead machine. There is sufficient shed space so that four to five days run of these sizes can be cured under cover. In the summer, the pipe attains nearly its full strength in four days. The green pipe on 4-foot by 8-foot platforms is conveyed from the pipe machine to the curing rooms by Louden overhead

carriers. With this system, one man spends one-half of his time at this operation. Some other systems require three men for this operation. The curing room is provided with an overhead Skinner sprinkling system which throws a fine mist over the pipe, making ideal curing conditions. Pipe is conveyed from the sheds to the storage yard on the same platform by the overhead carrier where it is unloaded and piled. There is storage for 200,000 feet in this end of the yard. The pipe is kept wet outside until ten days to two weeks old.

The concrete pipe aggregates consist of  $\frac{1}{2}$ -inch pea gravel, coarse sand, fine canal sand and pulverized limestone for a filler. They are proportioned so as to yield concrete of maximum density and strength. This is accomplished by making mechanical analysis tests from time to time and checking the curve of the mixed materials against a standard curve devised by the engineering department for this particular purpose.

The proportion of cement to aggregate is 1 to  $4\frac{1}{2}$  for the smaller sizes. No pipe is cement washed inside, as the walls are sufficiently dense to prevent seepage.

Pipe 18 inches to 30 inches in diameter is made by pneumatic tampers. There is shed space for two to three days run from two crews. This pipe is rolled outside under an overhead Skinner sprinkling system where it is kept continually wet for from ten days to two weeks.

Settlers fill practically every job in the factory. When running to capacity, thirty men are employed. All the men of the machine crew receive 50 cents per hour plus a bonus for every joint over a fixed day's run. The crews on large pipe work on a piece rate basis. Miscellaneous work pays 40 to 50 cents per hour.

The following table shows the daily capacity of factory per crew:

Size	Average output per crew in feet.	Number of men on crew	Method of manufacturing
30-inch -----	180	5	Air tamp
24-inch -----	200	5	Air tamp
20-inch -----	240	5	Air tamp
18-inch -----	280	5	Air tamp
16-inch -----	900	7	Machine
14-inch -----	1,050	7	Machine
12-inch -----	1,150	6	Machine
10-inch -----	1,100	6	Machine
8-inch -----	1,100	5	Machine

During the rush season the pipe machine was operated sixteen hours a day, while two crews worked one shift on the large sizes. The maximum output in any one day on the machine was 3000 feet in sixteen hours.

The maximum run for one crew on large pipe was 520 feet of 18-inch in eight hours.

The average output for all sizes is from 2500 to 3000 feet per day.

The total output for two years has been 580,000 feet, or 110 miles.

Tests of cured pipe were made at certain intervals to check the quality of the pipe. All pipe tested met the standard strength requirements of the California Associated Concrete Pipe Manufacturers; that

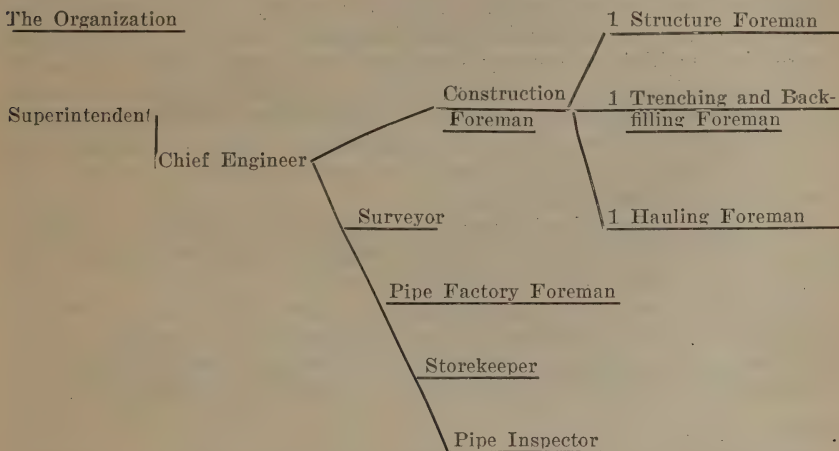
is, a tensile strength of 200 pounds per square inch. In one case a tensile strength of 590 pounds per square inch was attained on a 12-inch pipe. An 18-inch air-tamped pipe showed a tensile strength of 514 pounds per square inch at the age of one month.

Much assistance has been obtained from the California Associated Concrete Pipe Manufacturers, both in planning the factory and making tests.

During the past year Mr. T. M. Temple has had charge of the factory, spending his whole time in supervision during the rush season and part time during the summer months.

#### Installation.

##### The Organization



The attached tables show the unit installation cost for years 1920-22.

To date, 501,353 feet, or 95 miles, of concrete pipe have been installed. The pipe laying was all contracted. The contractor furnished cement and lime and hauled all materials except concrete pipe. The Merced Pipe Company of Merced and John R. Kristrich of King City have laid most of the pipe. Last spring two crews of layers from the settlement were used for several months. The average price for laying is shown in the tabulation.



The bulk of the work was done between November and April of both years. During this period the soil is moist and in good condition to cure mortar around the joints. The trenches also stand up well when the soil is damp. The maximum footage of pipe laid in any one month was 87,000 feet, using seven crews.

#### **Trenching.**

All trenching is done under supervision of the Delhi Land Settlement. The smaller trenches were all dug by hand last year, but the winter before a small trenching machine owned by J. E. Funk, which excavated several miles of trench, was used. Trenches for pipe 8 inches to 16 inches in diameter are principally dug by hand. The rate of pay for this work for the second season was 18 cents per yard, paying double for picked material and slightly more for graded ditches. One foreman employing as high as seventy men supervised this work. The larger trenches for 18-inch to 30-inch pipe were principally dug by a Parsons excavator. This machine is capable of excavating 800 feet of trench a day to receive 30-inch pipe. It is necessary, however, to clean and drain the trench by hand. There have been 9.89 miles of trench excavated by the Parsons machine.

From four to six Ford trucks were used all last winter in hauling pipe. The rate of pay for this work was \$1.50 an hour. One of the truck drivers efficiently supervised this work.

Backfilling was done principally by team work, using Mormon scrapers and "V" crowders. A price slightly lower than the tabulation was used as a base. A slightly higher rate was paid for deep cuts. This work was all checked by the man in charge of the trenching.

#### **Roads.**

The county of Merced has furnished rock screenings for 7 miles of road, 10 feet wide and 6 inches deep, along El Capitan way, First Avenue South, Hinton avenue and Baumgartner road. The road bed was prepared by the settlement. The Delhi Land Settlement has graveled 8000 feet along Wilson street and First Avenue South, using waste material from the pipe factory.

#### **Drainage.**

Although a large quantity of water is saved by the concrete pipe system that would otherwise raise the ground water level, irrigation is causing water to appear on the surface on some of the low spots of the settlement. Professor Walter Wier of the University of California has located eight test wells radiating out from two pumping plants, which are run more or less continuously for irrigation purposes, to observe the effect of pumping on the water table. These wells show that the pumping plants are maintaining the water table within a radius of at least 1000 feet from the pumps. A general survey of the water table throughout the settlement has been made and observations will be made several times during each year. The Turlock Irrigation District has located two wells for pumping purposes on the edge of the settlement to experiment with drainage by pumping. In all probability the district will have a very extensive system of pumping plants for drainage when cheap power is obtainable from Don Pedro dam

COSTS PER LINEAL FOOT, INSTALLATION OF CONCRETE PIPE SYSTEM, DELHI COLONY, NOVEMBER 1921, TO JUNE, 1922.

Diameter	Total footage installed	Factory cost	Trenching	Hauling	Laying	Back filling	Miscellaneous	Add 10 per cent	Total unit cost	Selling price as sat 1921
30	315	\$1 40	\$0 250	\$0 152	\$0 44	\$0 08	\$0 152	\$0 247	\$2 721	\$3 036
24	7,920	857	180	133	26	-075	108	161	1 774	1 925
20	10,801	600	140	087	215	055	083	118	1 298	1 556
18	4,800	511	100	063	172	035	062	094	1 037	1 09
16	4,788	334	067	049	140	027	047	066	730	837
14	65,359	258	050	038	120	022	038	053	579	708
12	87,971	209	044	032	103	015	032	044	479	583
10	72,081	176	044	025	091	015	029	038	418	418
8	12,428	141	032	015	084	010	024	031	337	334

UNIT COSTS PER LINEAL FOOT, INSTALLATION OF CONCRETE PIPE, DELHI COLONY, NOVEMBER, 1920, TO AUGUST, 1921.

[illegible]

### SUMMARY OF OPERATIONS, 1920-1922.

Total cost of irrigation system to date.....	\$388,302 88
Cost per acre of farmers' concrete pipe laterals.....	43 51
Cost per acre of main lines, including ten pumping plants and concrete structures .....	34 45
Total miles of pipe installed.....	95
Miles of main pipe line installed.....	34
Miles of farmers' pipe laterals.....	61
Electric pumping plants installed.....	12
Total acreage piped with farmers' laterals.....	4,174
Total acreage served by mains.....	6,000

### DELHI COLONY DEPARTMENT OF PUBLIC WORKS, DIVISION OF LAND SETTLEMENT.

Balance Sheet as of June 30, 1922.

<i>Assets.</i>		
Available cash.....		\$15,530 30
Appropriated funds, chapter 450, 1919.....	\$6,520 83	
(Includes in transit, State Treasurer, \$6,870.79.)		
Appropriated funds, chapter 15, 1921.....	556 66	
Appropriated funds, chapter 734, 1921.....	26 31	
First National Bank, Turlock, revolving fund.....	4,000 00	
First National Bank, Turlock, warrant account.....	4,426 50	
Due on settlers' contracts.....		42,131 28
For land.....	\$35,432 99	
Improvements.....	6,698 29	
Due on settlers' notes receivable.....		5,356 91
Accounts receivable.....		28,644 29
Lease contracts, rentals due.....		491 00
Taxes, delinquent payments.....		3,877 13
Irrigation maintenance.....		2,268 34
Total current assets.....		\$98,299 25
Settlers' contracts—deferred principal.....		813,433 06
For land.....	\$765,722 77	
Improvements.....	47,710 29	
Settlers' notes receivable—deferred principal.....		106,591 87
Lease contracts.....		2,392 00
Land.....		439,683 28
Improvements.....		91,590 98
Stores.....		8,408 32
Uncompleted construction contracts awarded.....		2,245 00
Trust fund (First National Bank, Turlock).....		4,459 68
Equipment.....		78,683 28
		\$1,645,786 72
Deficit .....		*352,837 61
		\$1,998,624 33

\*The deficit shown in the report does not represent the financial status of the settlement.

The assets as shown do not include the selling price of unsold land, nor an item of \$181,000 for distributing pipe which has been installed, but was not definitely charged to settlers until after June 30, 1922.

The project shows a surplus of \$250,000 when all unsold land is accounted for.



*Liabilities.*

Claims payable .....		\$13,969 28
Liability amount due Department of Irrigation investigations .....		1,087 04
		<hr/>
Total current liabilities .....		\$15,006 32
State of California .....		1,972,701 33
Total appropriated, chapter 450, 1919 .....	\$875,519 48	
(Delhi apportionment.)		
For expended loan .....	\$868,998 65	
For unexpended loan .....	6,520 83	
Total appropriated, chapter 15, 1921 .....		250,000 00
For expended loan .....	\$249,443 34	
For unexpended loan .....	556 66	
Total appropriated, chapter 734, 1921 .....		750,000 00
For expended loan .....	\$749,973 69	
For unexpended loan .....	26 31	
Add for interest on expended loan .....		97,181 85
Appropriated fund, chapter 450, 1919 ..	\$73,429 84	
Appropriated fund, chapter 15, 1921 ..	10,468 17	
Appropriated fund, chapter 734, 1921 ..	13,283 84	
Liability uncompleted construction contracts .....		2,245 00
Liability improvements to be effected for settlers .....		1,820 00
Liability special deposit trust account .....		4,459 68
		<hr/>
Total liabilities .....		\$1,996,232 33
Reserve for lease contracts .....		2,392 00
		<hr/>
		\$1,998,624 33

DELHI COLONY DEPARTMENT OF PUBLIC WORKS, DIVISION OF LAND SETTLEMENT.

Statement of Operations and Development from Commencement of Operations to June 30, 1922.

<i>Expenditures.</i>		
Development		\$599,510 80
Bridges	\$1,492 50	
Culverts	293 40	
Fences	352 80	
Roads	11,274 89	
Planting crops	11,813 31	
Growing crops	8,446 51	
Harvesting crops	710 89	
Replanting vineyards and alfalfa	937 04	
Pest extermination	3,512 07	
Farmstead layouts	9,600 45	
Drainage	38 50	
Irrigation design	1,634 50	
Irrigation layout	5,878 89	
Irrigation ditches	365 62	
Subdivisional survey	5,737 93	
Subdivisional mapping	1,814 62	
Topographical survey	3,505 85	
Topographical mapping	2,379 59	
Soil survey	247 27	
Consulting engineers' services	2,011 54	
Engineering service to settlers	2,196 05	
East townsite	1,827 25	
West townsite	4,522 11	
Pipe manufacturing	179,573 74	
Irrigation pipe lines	177,502 07	
Pipe line repairs	1,816 27	
Irrigation pipe line structure	43,569 99	
Irrigation pipe line structure repairs	315 93	
Well development	2,335 12	
Land leveling and grading	61,682 75	
Railway spurs	19,340 37	
Colony nursery	5,038 53	
Repairs of implements	14,157 03	
Truck supplies and repair parts	3,052 06	
Repair wind damage	4,377 89	
Yard work general	2,952 15	
Miscellaneous development expenses	3,203 32	
Operating expenses		14,641 31
Freight and express	\$2,626 34	
Insurance	846 04	
Telephone and telegraph	1,762 71	
Irrigation maintenance	3,335 85	
Railway maintenance	758 00	
Repair buildings	312 28	
Rental right of way space Southern Pacific Company	5 00	
Telephone system upkeep	39 08	
Depreciation of equipment actual	3,983 60	
Depreciation of buildings	716 82	
Miscellaneous operating expense	5 84	
Fuel	249 75	

Administration .....		86,797 44
Administrative salaries.....	\$56,710 63	
Traveling expenses.....	3,808 80	
Office expense and supplies.....	7,357 63	
Auto expense.....	14,574 56	
Advertising, publication of notices, etc.....	1,111 11	
Berkeley office.....	398 26	
Central office overhead—Sacramento.....	2,836 45	
Interest .....		148,136 36
Taxes .....		19,749 81
Admittance Turlock Irrigation District.....		54,071 68
Total expenditures .....		<u>\$922,907 40</u>

*Income.*

Amount added to cost of land sold.....	\$472,900 33	
Amount added to cost of land townsite.....	3,327 66	
Application fees.....	1,312 50	
Defaulted contracts.....	172 01	
Discounts taken.....	13 22	
Sale of domestic water.....	30 70	
Farm land rentals.....	286 82	
Sale of plans and specifications and 3 per cent farmstead fees.....	1,726 61	
Crops .....	5,061 93	
Interest, installment contracts.....	58,197 99	
Interest, settlers' notes receivable.....	4,126 71	
Engineering service.....	73 75	
Delinquency charge overdue tax payments.....	59 90	
Mail delivery .....	44 68	
Rental of buildings.....	7,781 65	
Pasturage rental.....	7,097 50	
Rental experimental farm.....	900 00	
Rental of implements.....	400 79	
Rental of sign space.....	90 00	
Rental of town lots.....	90 00	
Tractor rental.....	783 79	
Repair work.....	356 36	
Sale of concrete pipe.....	2,139 34	
Sale of old buildings.....	153 50	
Sale of store material.....	2,443 92	
Transportation .....	106 13	
Trucking .....	386 50	
Stenographic work, miscellaneous.....	5 50	
		<u>\$570,069 79</u>
Deficit .....		<u>352,837 61</u>
Total.....		<u>\$922,907 40</u>



1892

PART VI

REPORT

OF THE

Division of Architecture

A SUBDIVISION OF THE

DEPARTMENT OF PUBLIC WORKS

OF THE

STATE OF CALIFORNIA

*To Accompany the First Biennial Report  
of that Department*

NOVEMBER 1, 1922

GEO. B. McDOUGALL, Chief of Division



CALIFORNIA STATE PRINTING OFFICE  
SACRAMENTO, 1923



*San Francisco State Building, San Francisco, California.  
Under Construction October 20, 1922.*



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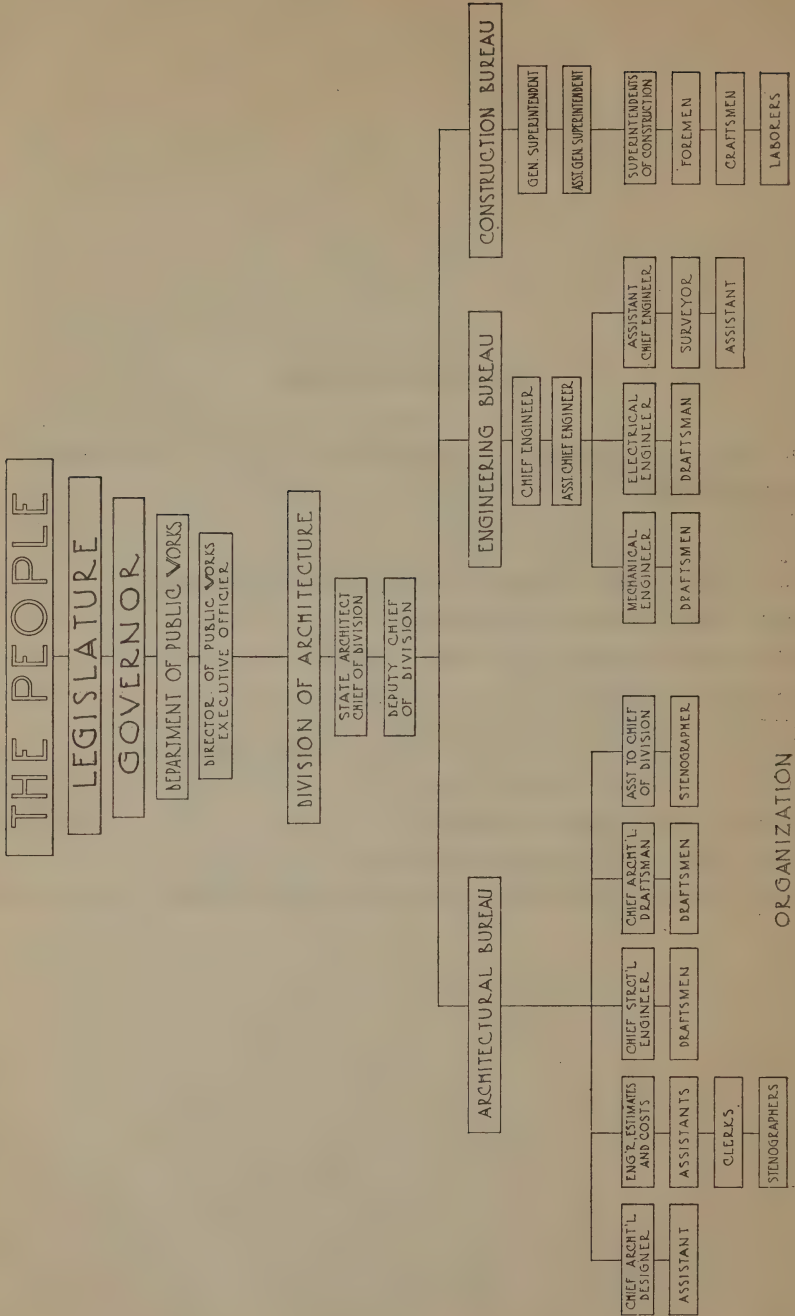
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## PERSONNEL.

WILLIAM D. STEPHENS.....Governor  
AUSTIN B. FLETCHER.....Director of Public Works

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GEO. B. MCDUGALL.....Chief, Division of Architecture  
GEO. J. ADAMS.....Deputy Chief, Division of Architecture

### ARCHITECTURAL BUREAU.

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L. B. MILLER.....Architectural Designer

#### Drafting.

L. F. SHERWOOD, Chief Architectural Draftsman.	H. V. ADAMS, Architectural Draftsman.
W. K. DANIELS, Architectural Draftsman.	PAUL DAUM, Architectural Draftsman.
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H. V. GRANT, Superintendent Building Construction.	A. G. MORTON, Timekeeper.
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O. L. MORTON, Superintendent Building Construction.	G. N. SARGENT, Electrical Foreman.
T. J. MULLINS, Superintendent Building Construction.	F. M. STEWART, Senior Clerk.
JOHN PEROZZI, Superintendent Building Construction.	C. E. STEPHENSON, Foreman of Construction.

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MAE SULLIVAN, Stenographer.	
ANNIE THORBURN, Stenographer.	MRS. T. TOWLE, Stenographer.
MAE CHESHIRE, Typist.	





## REPORT OF THE DIVISION OF ARCHITECTURE. STATE DEPARTMENT OF PUBLIC WORKS.

GEO. B. McDOUGALL,  
Chief of Division.

(NOTE.—Report and financial statement of the Bureau of Architecture of the former Department of Engineering for the period November 1, 1920, to July 29, 1921, the latter being the date when the former Department of Engineering ceased to exist, will be found in the Appendix at the end of this Report.)

### HISTORY AND PURPOSE.

The State Department of Engineering, of which the Bureau of Architecture was a part, was created by an act of the legislature, approved March 11, 1907, chapter 183, Statutes of the year 1907, and was organized in the May following. The Bureau of Architecture was organized very shortly thereafter and immediately began its activities.

On July 30, 1921, changes in the organization of the State government, as made by the legislature of 1921 and approved by the Governor went into effect. The former Department of Engineering with its Bureau of Architecture was abolished and its functions transferred to the Department of Public Works with five divisions, of which the Division of Architecture is one. The activities of the Division of Architecture and the former Bureau of Architecture cover therefore a period of approximately fifteen years.

During the first few years of its existence, the work of the Bureau of Architecture consisted almost entirely of the preparation of plans and specifications for new buildings, repairs and alterations to existing buildings, and general supervision of the construction thereof. The work was therefore similar to that of the average architect of private practice, except for the fact that construction has in most cases been at a considerable distance from the central office. As the years have passed, however, the responsibilities have constantly increased, as has also the number of institutions and general building activity in the state, until the present large force is required to handle the work. The duties of the Division of Architecture at the present time may be summed up as follows:

To make plans and specifications for all new buildings of a value in excess of \$1,000 at the various state institutions; to let contracts for and superintend their erection or in case satisfactory contracts can not be made, to construct the buildings by day labor; to care for all alterations and repairs to existing buildings, on the same basis where the amount involved is in excess of \$1,000; to design and install all heating, lighting, ventilating, refrigerating, water supply, mechanical and electrical plants of every nature—whether changes, extensions, or original; survey grounds, lay out walks, drives and roads; provide water supply, sewer and drainage systems, requiring the design and construction of dams, reservoirs, pipe lines, wells, pumping plants, ditches, sewage treatment and disposal plants and drains.

The State of California has at the present time twenty-eight major institutions, at which the bureau functions as outlined in the preceding paragraph. In addition to these, there were twenty-seven places at which either construction of some kind was supervised, or expert assistance given during the past two years.

These fifty-five points of activity are scattered from one end of the state to the other; this element of distances to overcome, being one of the most difficult of the conditions surrounding the activities of the bureau. The map printed herewith shows the names and location of all these places.

#### ORGANIZATION.

The organization of the Division of Architecture together with the number and distribution of its employees are indicated by an organization chart and personnel on pages 3 and 4. In addition, the Division maintains in conjunction with the Division of Engineering and Irrigation an accounting department of seven employees and assists in the maintenance of the central office and accounting department of the Department of Public Works and the purchasing section of the Division of Highways.

The present organization which is the result of gradual evolution and a thorough study by the executive heads of the Division, has proven to be practically perfect by more than five years of experience. Definite authority and responsibility has been fixed to such a degree that friction and overlapping of activities is reduced to a minimum. The nature of the work of the Division and of the State's property at its various institutions is such as to require the services of the heads of the various branches and of some other employees in the three bureaus making up the Division continuously during twelve months of the year. The duties of these men are executive or of a general character that renders a proper segregation of the time spent on different jobs impracticable. There are twenty of these continuously employed and they make up what might be considered as the skeleton organization of the Division.

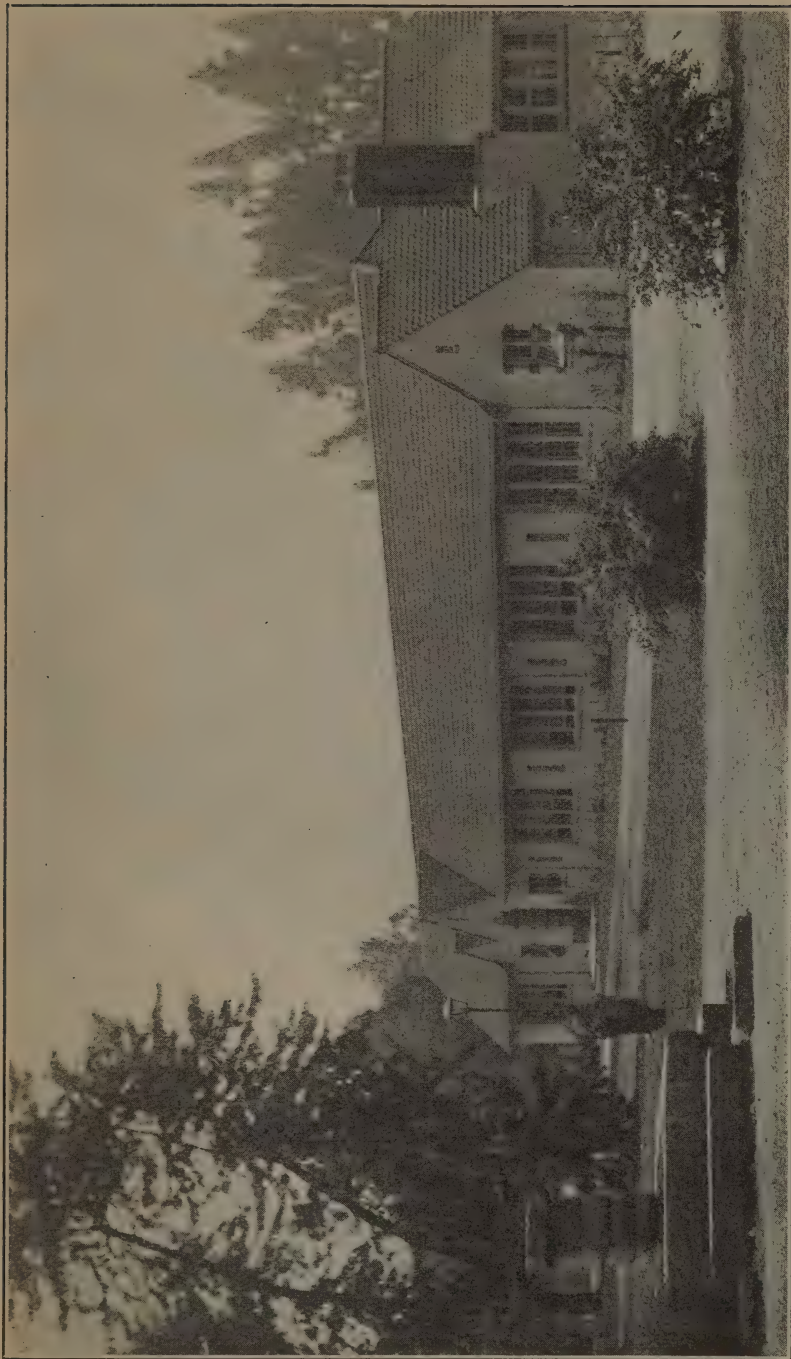
#### FINANCES OF THE DIVISION.

The expenses attendant upon the operation of the Division of Architecture are met as follows:

(1) By an appropriation of \$9,600 for the salary of the Chief of the Division in the General Fund.

(2) Under chapter 905 the legislature of 1921 provided for the statutory positions in the former Department of Engineering the sum of \$165,040 for salaries. During the period from July 1, 1921, to July 29, 1921, inclusive, the sum of \$5,341.27 was spent for salaries by the Department of Engineering from this fund. Upon the reorganization of the Department following the latter date, the balance in the fund, \$159,698.73, was allotted on a basis of 80 per cent to the Division of Architecture and 20 per cent to the Division of Engineering and Irrigation. This segregation gave the Division of Architecture the sum of \$61,742.98 for salaries for the balance of the seventy-third fiscal year, and \$66,016 for the seventy-fourth fiscal year. These funds are used to cover the salaries of the skeleton organization.

(3) Other employees including architectural, mechanical and electrical draftsmen, estimators, and others whose work is special in character, are paid out of the special appropriations for construction. An exact record of the time spent on each project is kept and the value of this time, based on salary paid, is deducted from the appropriation at the end of each month.



School Building, Whittier State School, Whittier, California.



(4) By a special appropriation for contingencies which covers traveling expenses, including automobiles as required by the employees continuously employed, telegraph and telephone, postage, office supplies, rent, furniture, the Division's proportion of expense of maintaining the central office of the Department of Public Works, etc.

(5) By a special appropriation for printing.

#### OPERATION OF THE DIVISION.

Under the subject of operation, the activities of the Division of Architecture can be listed under three main subdivisions:

- (1) Construction by contract or subcontracts.
- (2) Construction by day labor.
- (3) Miscellaneous activities.

A brief explanation of the services performed under each of the three headings will give an understanding of services that are being rendered.

##### **Construction by Contract.**

A full understanding of the project in hand is first obtained by visits to the site by the members of the bureau most intimately concerned, and by full discussions with the head of the institution and his or her assistants. Complete preliminary sketches and itemized estimates of cost based on them are made; conferences are continued with the institution authorities and any required adjustments made, until both the plans and the estimated cost are satisfactory. Formal approvals on the above are then requested of those in authority to proceed with the work on a definite basis. These being given the working drawings are then prepared, including the architectural, structural, mechanical and electrical scale drawings, and all typical full-size architectural details. Specifications are written covering all branches of the work separated according to trades involved. After bids have been received, the contract papers are executed, additional approvals obtained, after which actual construction is ordered ahead. A special inspector is put in charge, in accordance with the requirements of law, to see that the interests of the state are protected. On small and relatively unimportant projects, this requirement is often met by securing the assistance of an institution official, qualified and willing to care for the work along with his regular duties.

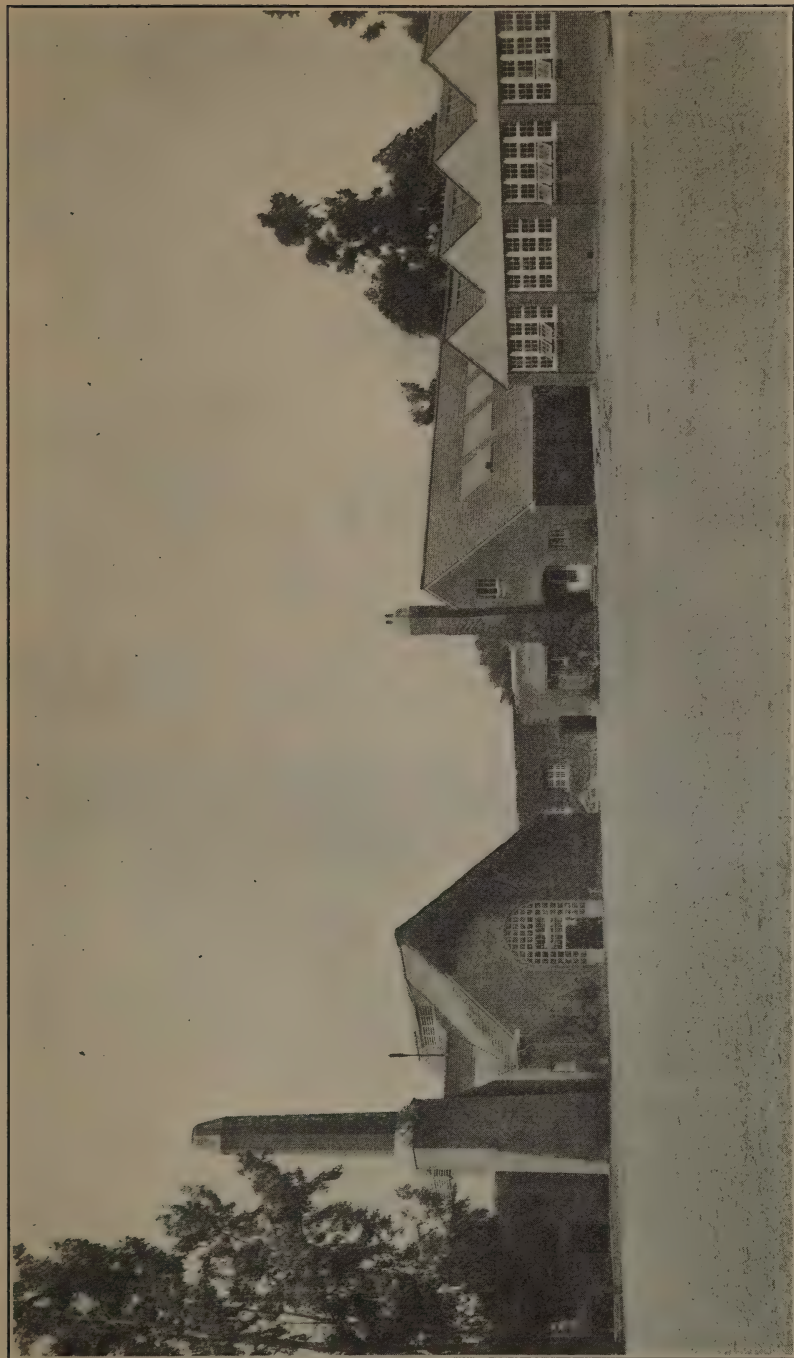
The office maintains a constant general supervision over all work in the field by periodical trips, correspondence, etc.

The auditing of all accounts, payments of all claims, and similar work is cared for by the Accounting Department. This is considerably more complicated and burdensome than would be necessary in private practice, due to the many exactions of the state laws and customs, and the endless chain of "approvals" necessary for each transaction no matter how small. In other words, the usual and necessary "red tape" that exists in connection with all public work, is a part of the burden to be carried.

##### **Construction by Day Labor.**

The method used in handling this type of work is exactly the same as for contracts up to the point of making working drawings. As the





Industrial Group, Whittier State School, Whittier, California.

construction is in the direct charge of the Division, it is not necessary that such complete drawings be prepared. No specifications are written, the necessary information being conveyed by notes on the drawings, or by letter to the inspector or general foreman in charge.

Complete bills of materials, for all branches of the work are prepared in the office, and where practicable are checked by the representative in the field. Requisitions are then prepared and sent to the purchasing agent who attends to the actual purchases. Great care is necessary in the preparation of the lists and descriptions, as the whole transaction lacks the possibility of personal touch between buyer and seller; and, as the average time required from the issuance of the requisition to the delivery of the material is about three weeks, it is obvious that mistakes in deliveries, which could disrupt the entire program of construction, must be prevented.

In connection with mill work and similar items, it has been found advantageous to detail and list off accurately every piece of milled stock required, all doors, sash, etc., and furnish the bidders with such complete information. This takes the place of the usual "mill bid" of commercial practice, where there is always a chance of misunderstanding as to limits of requirements, and which furthermore requires each and every bidder to list off the materials for which unnecessary multiple service the State would have to pay. Such work naturally increases overhead costs, but this is considerably more than offset by the lower bids received for the materials.

All necessary mechanics and laborers are employed direct, this alone requiring considerable attention by the office force, due to the necessity of securing such assistance through the medium of the Civil Service Commission, with the attendant additional burden of clerical work.

All accounts are audited as mentioned under contract work, these representing much more detail, since all claims for labor, and every individual purchase of materials must be taken care of separately.

Day labor construction work is handled in the field by a competent superintendent of construction; this agent of the Division being an active director of construction work rather than one who simply inspects the work of others as in the case of contract work. At weekly intervals on day labor work he reports to the office on the total amount of work done on a project, which, with the segregation of his payroll and cost accounting system maintained in the central office enables the Division at any time to know whether or not a project is being completed within the original amount estimated.

### **Miscellaneous Work.**

This subdivision includes all the activities of various divisions of the bureau, over and above those directly related to projects for which money has actually been appropriated.

Assistance of an advisory nature is constantly being rendered the various departments and institutions, in connection with technical subjects. Sketches and estimates are prepared for considerable proposed work that is never carried to completion. Development plans for the new institutions, and for proposed changes in the older ones, are constantly being worked on. Also plot plans showing existing conditions, that the bureau has never been able to finance in a comprehensive

way, and the lack of which represents a serious handicap, are kept up to date to the best of our ability.

It is not possible to give an accurate account of the amount of time spent by the employees of the Division on this miscellaneous work. It is safe to say, however, that as a minimum estimate one-third of the time of the employees included in the skeleton organization is devoted to the handling of these miscellaneous details.

When working drawings for a project are started in the drafting room a decision is made by the executive head of the Division on the method of construction to be followed, that is, whether the work shall go ahead on a basis of contracts, subcontracts, or day labor. The contract method is used where the work is conveniently located, where the estimates indicate that the cost will be large enough to attract sufficient bidding, where the State is unable to supply any labor or materials, and when some special type of labor or equipment is needed for the proper execution of the work.

Subcontracts are made in some cases rather than a general contract where it can be demonstrated that a saving to the State can be effected in handling the work in this manner. When such a procedure is followed the Division of Architecture acts in the same capacity as a general contractor. Construction work on the San Francisco and Sacramento state buildings is being carried on by the subcontract method.

The day labor plan is adopted at some institutions where institutional labor is available for construction work, at isolated institutions which do not attract the bidding of contractors, and on some repair and alteration jobs which are often difficult to cover by contract. In many cases where a job is handled by day labor certain portions of



Airplane View, Norwalk State Hospital, Norwalk, California.



the work are let to subcontractors where it is demonstrated that a saving to the State can be made or a better grade of work secured.

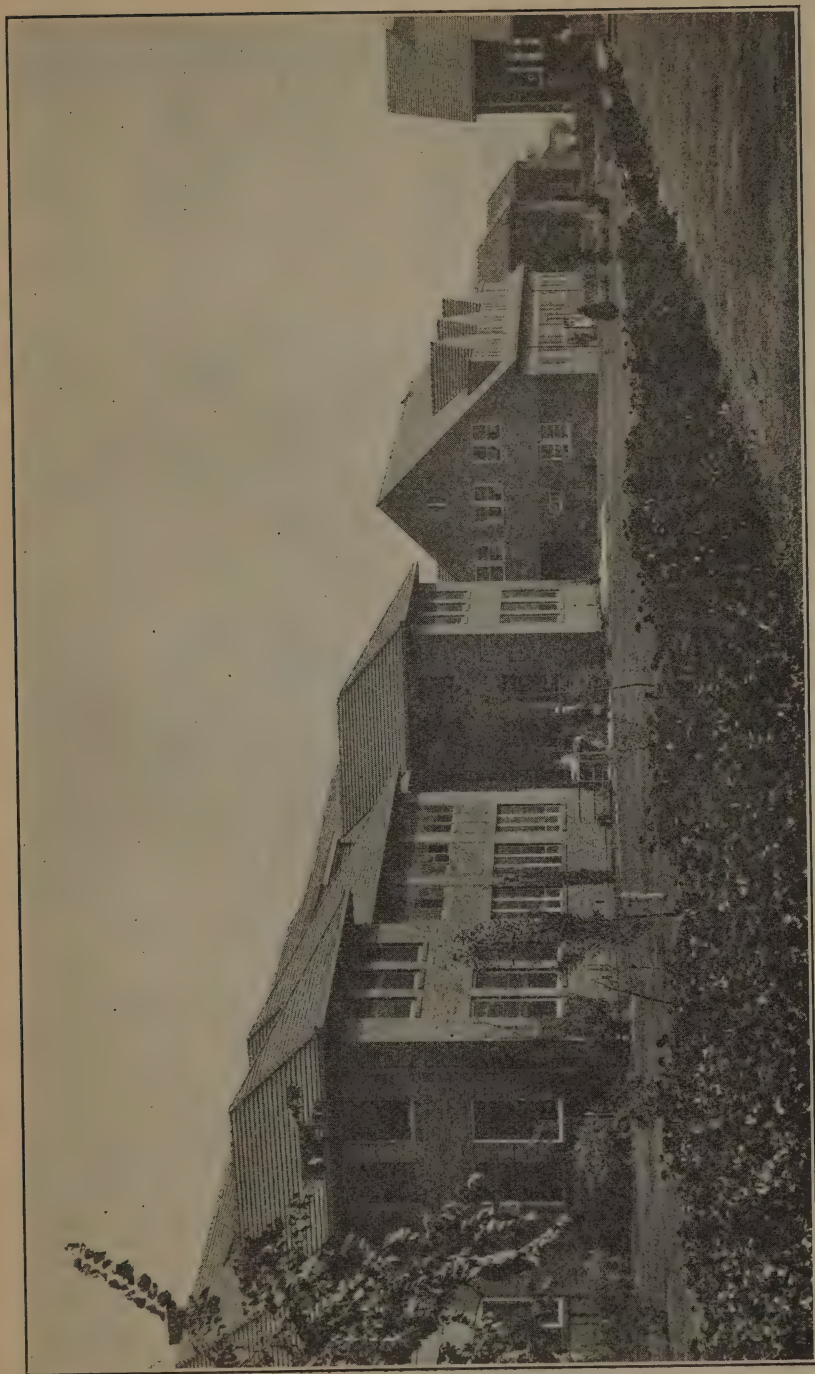
Indicating the advantages of the contract method is the work now being carried on at the Preston School of Industry at Ione, California, in developing an adequate water supply system. At an expenditure of approximately \$30,000 the Division of Architecture has contracted for the raising of the present earth filled dam and the relining of the ditch conveying the water from the reservoir to the main buildings of the Institution. The earth work on the dam calls for the use of a large amount of labor and special equipment for the handling of earth which would be difficult for the Division of Architecture to obtain. In relining the ditch this work is being done with cement under pressure calling for men especially skilled in this work and special equipment.

As another example, during the month of August, 1922, the Division of Architecture handled the construction of the Horse Show Arena at the State Fair Grounds as a combination day labor and contract job. Due to the necessity for the completion of this building before the opening of the State Fair, the Division was allowed less than one month's time to prepare drawings and carry the building work on to completion. This time was not sufficient for the preparation of general contract drawings, an award on same and the construction work, nor was it time enough for a complete day labor job by the Division due to its lack of equipment and adequate labor. The Division, therefore, purchased while the drawings were being made the necessary lumber, 160,000 feet in all, and had same delivered from the Bay district, the only source of supply, and then immediately contracted for the labor on informal bids, which permitted the satisfactory completion of the work.

Indicating the advantages of the day labor method of construction, there have been completed at the Southern California State Hospital, Patton, during the past year four cottages for patients, having a total capacity of approximately 300, at a total cost of about \$80,000, or at a cost per patient of approximately \$266. The total value of the labor and materials incorporated in this work, based either on the contract or the day labor method of construction, aggregates nearly \$120,000, or at a rate of nearly \$400 per patient. In addition to these very important financial savings are the mental and physical benefits which the patients derive from their connection with the work. Dr. John A. Reily, former medical superintendent of the institution at Patton, afterwards Director of the State Department of Institutions, and now again returned to the institution as its medical superintendent, states that work of this kind is good for the patients since the interest it gives them in accomplishment, even though they are not compensated, carries them toward a normal existence.

These savings made at the Southern California State Hospital were brought about by the use of the day labor system of construction, which permitted the use of all the assistance the institution could offer. Several crews of insane patients were assigned to the jobs to act as common laborers and to assist the skilled tradesmen as well. There were also some patients found who were equipped to do carpentry work, plastering, concrete work, painting, etc. The engineering force at the Hospital, in addition to performing its regular duties, supplied the





Female Cottage, Officers' Dining Room, etc., Norwalk State Hospital, Norwalk, California.

labor for the mechanical and electric installations, and the institution trucks hauled all materials.

The Division of Architecture directed this work through its superintendent of construction, purchased all the materials, and supplied the small amount of labor which the hospital could not furnish.

It has been demonstrated that considerable saving can be made to the State at several of the other State institutions as well by the use of the day labor system, and this accounts for the fact that this method of construction is being extensively used by the Division at this time.

In view of the fact that from four to six weeks elapse from the time obligations accrue until the claims covering them can be approved and paid, the legislature has provided for the use of the department a cash revolving fund of \$30,000 appropriated by chapter 419, Statutes of the year 1917, to be used in advancing cash payments for labor, material and supply bills where such payments are necessary for the proper conduct of the business of the Department.

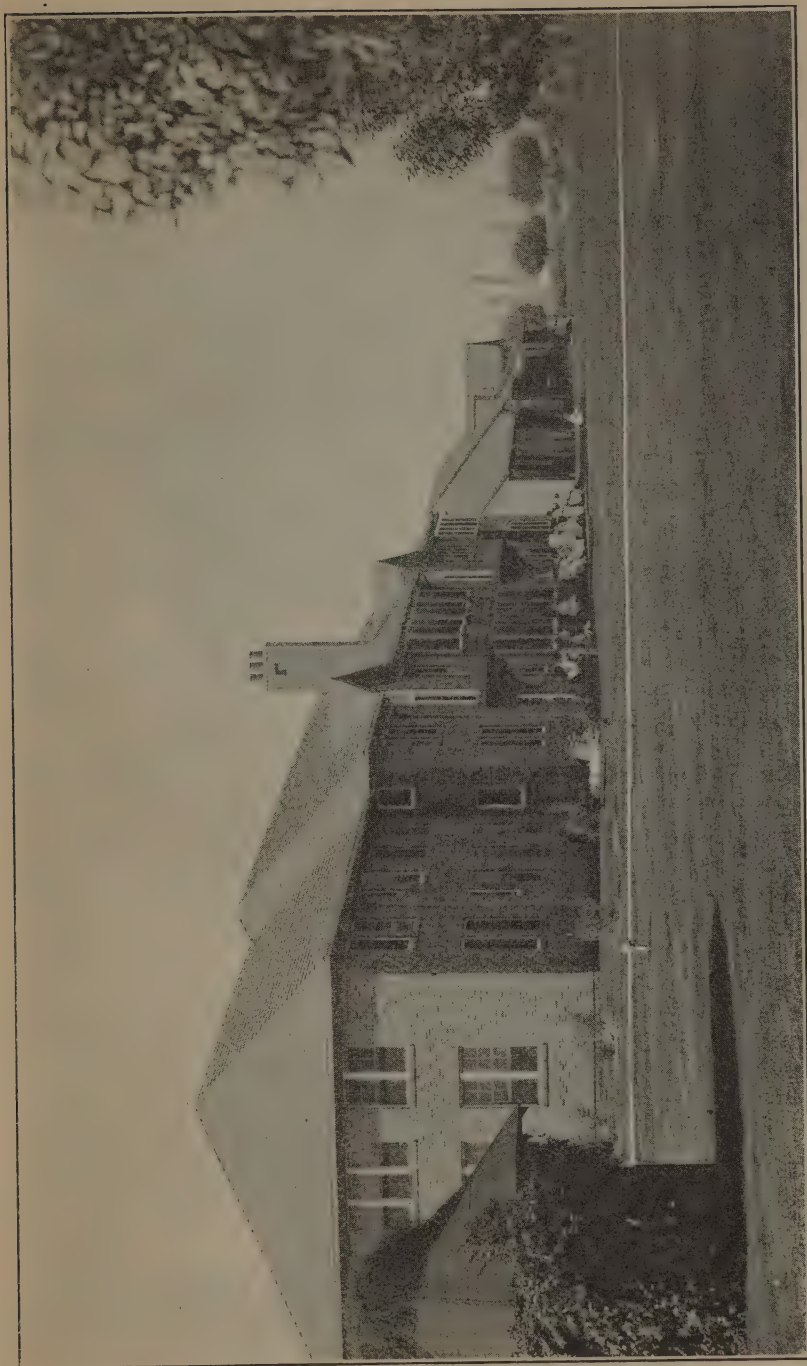
This cash revolving fund of \$30,000 is for the joint use of the Division of Engineering and Irrigation and the Division of Architecture, \$7,000 having been allotted to the Division of Engineering and Irrigation and \$23,000 to the Division of Architecture.

The volume of day labor work being done by the Division of Architecture as indicated hereinabove is such that this amount of \$23,000 has proven insufficient, so much so that the Department of Finance has loaned to the Division to be paid back on demand, the sum of \$25,000 in two amounts, \$10,000 at one time and \$15,000 at a later time. With this present total of \$48,000 available to the Division of Architecture, we are still unable to avoid overdrafts at the bank. Therefore, instead of the present revolving fund of \$30,000 for the joint use of the Division of Engineering and Irrigation and the Division of Architecture, there should be made available through act of the legislature a cash revolving fund of \$60,000 for the exclusive use of the Division of Architecture; provision for the Division of Engineering and Irrigation to be made separately or by increasing this amount of \$60,000 as required to cover also the needs of that Division.

#### FUNDS AVAILABLE FOR CONSTRUCTION WORK.

On July 30, 1921, there became available a total of \$4,026,602.79 in special appropriations made by the 1921 legislature for building construction. To this total must be added \$728,338.94, which is being expended during the present biennium on the construction of the San Francisco state building, and \$3,000,000 now being expended on the Sacramento state buildings, the latter having been in the course of actual construction since February, 1922; also the further sum of \$305,524.43 made up of appropriations made prior to 1921 but expended subsequent to July 30, 1921; also the further sum of \$109,517 made up of moneys turned over to the Department of Public Works from contingent and other funds of institutions to cover the cost of construction work. These several amounts taken together make a grand total of \$8,169,983.16.

Some of the special appropriations mentioned above as made by the 1921 legislature and totaling \$4,026,602.79, include items budgeted for the use of the institutions themselves in purchasing equipment, etc.,



Female Cottages, Norwalk State Hospital, Norwalk, California.



which does not interest this Division. For this reason a portion of the money appropriated has been turned over to the institutions for their own use, the total amount of these transfers being \$768,103.77, therefore, the net amount available for construction work during the biennium is \$7,401,879.39.

#### PROGRESS OF WORK USING AVAILABLE FUNDS.

Using the funds mentioned above, the following report indicates the progress made on construction work by the Division of Architecture during the period from July 30, 1922, to August 1, 1922, or for the period of approximately one year after the 1921 appropriations became available. The report shows the work grouped under the various institutions, indicates the funds used, the various projects with actual or estimated costs under these funds and the status of the work on August 1, 1922.

Report Indicating Status of Construction Work Provided for by the 1921 Legislature and Showing the Progress Which Has Been Made During the Period of July 30, 1921, to August 1, 1922.

##### *Agnews State Hospital, Agnew.*

- Chap. 881-1921—Quarters for employees, \$100,000. Nothing has been done.  
Chap. 253-1921—Repairs, improvements and equipment, \$53,500.  
Pro. 17, W.O. 17—Mortuary building and greenhouses, \$4,278. Under construction.  
Pro. 18, W.O. 18—Repairs to boiler settings, \$815. Completed.  
Pro. 24, W.O. 19—Replacing lines in heating system, \$7,000. Completed.  
Pro. 51, W.O. 103—Removing hot water tanks and installing one new tank, \$880. Under construction.  
Pro. 102, W.O. 203—Refrigerating plant, \$13,500. Under construction.  
App. 97, W.O. 240—Transfer to institution, \$5,900.  
Chap. 252-1921—Repairs, improvements and dairy herd at farm, \$25,000.  
Chap. 252-1921—Business manager's residence, \$6,500. Sketches prepared.

##### *Agricultural Park, Sacramento.*

- Chap. 296-1921—Repairs and improvements, \$40,000.  
Pro. 90, W.O. 158—Cement finish on floor in agricultural building, \$5,000. Completed.  
Pro. 104, W.O. 182—Alterations to windows, manufactures building, \$480. Completed.  
Pro. 122, W.O. 219—Improvements to Fifth ave., \$5,799.95. Completed.  
Pro. 148, W.O. 265—Concrete slab, machinery building, \$600. Completed.  
Pro. 152, W.O. 273—Cork carpet, main office, \$600. Completed.  
Pro. 162, W.O. 292—Additions to education building, \$2,000. Under construction.  
Pro. 163, W.O. 293—Horse Show arena, \$7,000. Under construction.  
App. 155, W.O. 306—Transfer to Agricultural Society, \$1,163.66.  
App. 50, W.O. 167—Transfer to Agricultural Society, \$16,000.  
App. 79, W.O. 199—Transfer to Agricultural Society, \$2,000.

##### *California Polytechnic School.*

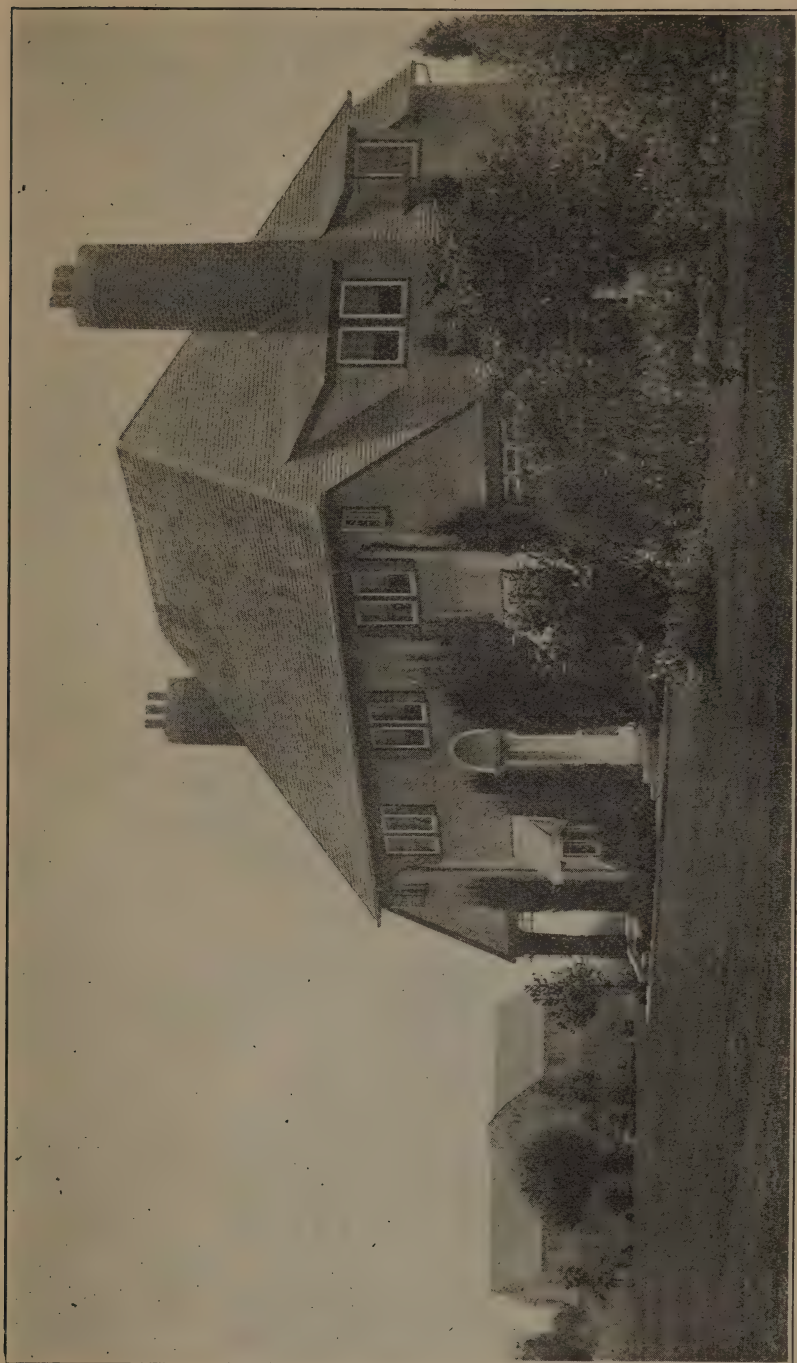
- Chap. 440-1921—Repairs, improvements and equipments, \$91,800.  
Pro. 2, W.O. 22—Repairs to dormitory and mess hall buildings, \$2,500. Completed.  
Pro. 23, W.O. 63—Repairs, farm houses, three cottages and administration building, \$3,000. Completed.  
Pro. 23-A, W.O. 63—Repairs, poultry buildings, creamery and miscellaneous, \$3,500. Under construction.  
App. 127, W.O. 270—Transfer to institution, \$6,000.  
App. 47, W.O. 154—Transfer to institution, \$3,500.  
App. 34, W.O. 104—Transfer to institution, \$15,000.  
Pro. 39, W.O. 24—Auto shop and warehouse building, \$14,000. Completed.  
Pro. 76, W.O. 148—Horse barn, \$4,005. Under construction.  
Pro. 76, W.O. 149—Hog pens, bull pens and exerciser, repairs to dairy barn, \$17,000. Under construction.  
Pro. 79, W.O. 150—Electrical repairs, \$15,500. Materials ordered.

##### *California Redwood Park.*

- Chap. 416-1921—Repairs, improvements and equipment, \$25,000.  
Pro. 16, W.O. 27—Construction of cabins, toilets, etc., \$11,000. Completed.  
App. 19, W.O. 25—Transfer to Redwood Park Commission, \$4,500.

on this project.

\*Total cost, \$13,000; \$6,000 being supplied from Institution Contingent Fund.  
†In addition to this amount, \$3,995 remaining in Chap. 315-1917 is being used



Superintendent's Residence, Administration Building in Background, Norwalk State Hospital, Norwalk, California.

*California School for Girls, Ventura.*

- Chap. 265-1921—Repairs, improvements, equipment and furnishing, \$45,500.  
Pro. 19, W.O. 106—Repairs to pump, \$225. Cancelled.  
Pro. 61, W.O. 107—Installation of gas mains, etc., \$3,500. Completed.  
Pro. 92, W.O. 181—Improvements to sewage disposal plant, \$1,100. Completed.  
Pro. 113, W.O. 195—Miscellaneous repairs, \$14,600. Under construction.  
Pro. 160, W.O. 308—Additional painting, \$6,000. Under construction.  
App. 93, W.O. 241—Transfer to Institution, \$15,000.  
Chap. 266-1921—Water supply, \$11,000.  
Pro. 142, W.O. 261—Irrigating System, \$1,700. Under construction.

*California School for the Deaf and the Blind, Berkeley.*

- Chap. 261-1921—Repairs, improvements and equipment, \$25,000.  
Pro. 10, W.O. 30—Plumbing repairs, \$450. Completed.  
Pro. 3, W.O. 29—Repairs, etc., \$700. Completed.  
Superintendent's cottage, \$8,500. Working drawings complete.  
Pro. 146, W.O. 264—Miscellaneous repairs, \$6,000. Under construction.  
Pro. 167, W.O. 304—Additional repair work, \$800. Under construction.  
App. 63, W.O. 176—Transfer to Institution, \$903.06.  
App. 80, W.O. 193—Transfer to Institution, \$2,596.94.

*Folsom State Prison, Folsom.*

- Chap. 394-1921—Repairs, improvements, completion of buildings and extension of wall, \$52,000.  
Pro. 11, W.O. 36—Completion school building, \$13,000. Under construction.  
Pro. 14, W.O. 38—General repairs, \$9,600. Under construction.  
Pro. 15, W.O. 39—Water screen and repairs to wiring, turbines, etc., \$13,800. Completed.  
Pro. 28, W.O. 40—Repairs to roof, officers and guards dining building, \$1,250. Completed.  
Pro. 38, W.O. 41—Pump and lines at sewage disposal plant, \$1,290. Completed.  
Pro. 44, W.O. 42—Dining room building exterior walls, \$2,400. Under construction.  
Pro. 43, W.O. 43—Railroad bridge, \$3,000. Completed.  
Pro. 145, W.O. 257—Heating hospital and warden's quarters, \$3,100. Under construction.  
Chap. 680-1921—Five cottages for employees and officers, \$15,000.  
Pro. 80, W.O. 145—Five cottages, \$9,250. Under construction.  
Pro. 11, W.O. 37—Two cottages, \$5,600. Completed.

*Fresno State Teachers College, Fresno.*

- Chap. 441-1921—Improvements to streets and grounds, \$20,000.  
App. 93, W.O. 232—Transfer to Institution, \$20,000.

*Humboldt Redwood Park.*

- Chap. 871-1921.  
Pro. 75, W.O. 111—Administration building, \$5,000. Completed.  
Pro. 75-A, W.O. 166—Additional work, \$1,000. Completed.  
Pro. 75-B, W.O. 286—Additional work, \$3,000. Under construction.

*Humboldt State Teachers College.*

- Chap. 565-1921—Completion of buildings, improvement to grounds and equipment, \$33,200.  
Pro. 1 and 1-A, W.O. 46—Completion, etc., \$33,200. Completed.

*Industrial Farm for Women, Sonoma.*

- Chap. 254-1921—Alterations, additions and improvements, \$24,000.  
Pro. 99, W.O. 191—Miscellaneous repairs, \$1,000. Being done as needed.  
Pro. 140, W.O. 258—Repairs to stone building, \$2,500. Completed.  
Pro. 143, W.O. 262—Refrigerating plant, \$2,600. Under construction.

*Industrial Home for Adult Blind, Oakland.*

- Chap. 687-1921—Buildings and Equipment, \$76,300.  
Recreation building and power house, \$40,000. Sketches completed.  
Women's shops, \$15,000. Sketches completed.  
Employees' building, \$18,000. Sketches completed.  
Chap. 397-1921—Repairs, improvements, furniture and equipment, \$12,500.  
Pro. 118, W.O. 217—Refrigerating plant, \$2,500. Under construction.  
Pro. 125, W.O. 220—Erection of fence, \$500. Completed.  
App. 99, W.O. 242—Transfer to Institution, \$5,500.

*Los Angeles Armory, Los Angeles.*

*National Guard Support Fund:*

- Pro. 73, W.O. 133—Changes in heating plant, \$3,650. Completed.  
Pro. 77-A, W.O. 155—Surfacing drill shed floor, \$9,500. Completed.  
Pro. 105, W.O. 185—Hot water heater, \$250. Completed.

*Mendocino State Hospital, Ukiah.*

- Chap. 255-1921—Repairs, improvements and equipment, \$62,660.  
Pro. 25, W.O. 54—Painting tanks, etc., \$1,400. Completed.  
Pro. 53, W.O. 55—Chemical fire engine, \$900. Completed.



Pro. 57, W.O. 56—Plumbing shop, \$3,250. Completed.  
 Pro 63, W.O. 108—Completion cottage for tubercular patients, \$6,300. Completed  
 Pro. 91, W.O. 172—Fire escape, \$2,000. Under construction.  
 Septic tank. Data secured.  
 Pro. 100, W.O. 178—Oil storage tank and boiler at switch, \$3,000. Completed.  
 Pro. 126, W.O. 221—Repairs to kitchen, \$15,000. Under construction.  
 Pro. 156, W.O. 289—Hauling river gravel, \$500. Under construction.  
 Pro. 157, W.O. 288—Boiler settings, \$3,000. Materials under order.  
 App. 43, W.O. 139—Transfer to Institution, \$5,000.  
 Chap. 256-1921—Water supply, \$25,000.  
 Pro. 159, W.O. 307—Steel water line, \$12,000. Office work complete.  
 Pro. 165, W.O. 211—Irrigating system, \$1,600. Office work complete.  
 Chap. 399-1921—Receiving building, \$150,000; \$144,000. Sketches completed.  
 Emergency Fund—Repairs to Ward 3, \$20,000. Completed.  
 Contingent Fund:  
 Pro. 96, W.O. 170—Alterations to Wards 1 and 2, \$12,000. Under construction.  
 Pro. 97, W.O. 171—Brick plant, \$10,000. Completed.  
 Pro. 97-A, W.O. 300—Brick plant, \$1,500. Completed.  
 Pro. 97-B, W.O. 321—Brick plant, \$2,000. Under construction.  
 Pro. 96-A, W.O. 263—Plumbing and electrical repairs, \$2,600. Under construction.  
 Chap. 739-1921—General improvements, \$25,000.

*Mission San Francisco De Solano, Sonoma.*

Chap. 910-1921—Completing the restoration, \$1,000.  
 Pro. 137, W.O. 235—Restoration, \$960. Completed.  
*Napa State Farm, Yountville.*  
 Chap. 739-1921—General improvements, \$25,000.  
 Pro. 29, W.O. 71—Refrigerating building, \$17,500. Completed.

*Napa State Hospital, Napa.*

Chap. 859-1921—Cottage for patients, \$100,000.  
 Pro. 88, W.O. 180—Cottage, \$63,000. Under construction.  
 App. 143, W.O. 303—Transfer to Institution, \$4,000.  
 Chap. 447-1921—Repairs, improvements and equipment, \$95,000.  
 Pro. 22, W.O. 74—Dolphins in Napa River, \$800. Completed.  
 Pro. 31, W.O. 75—Heating, Dozier cottages, \$4,645. Completed.  
 Pro. 43, W.O. 76—Oil storage tank, pump, etc., \$4,700. Under construction.  
 Pro. 52, W.O. 77—Septic tank, \$950. Completed.  
 Pro. 49, W.O. 78—Air compressor, \$6,150. Under construction.  
 Pro. 67, W.O. 109—Hot water tanks in laundry, \$740. Completed.  
 Pro. 86, W.O. 153—Completion, sheds and pens for bulls, \$625. Completed.  
 Pro. 123, W.O. 215—Repairs to electric wiring, \$35,000. Under construction.  
 Pro. 135, W.O. 237—Survey of property line, \$200. Completed.  
 Pro. 141, W.O. 260—Three hot water storage tanks, \$1,514. Completed.  
 Pro. 155, W.O. 291—Alterations to laundry, \$2,000. Under construction.  
 App. 40, W.O. 134—Transfer to Institution, \$2,571.66.  
 App. 45, W.O. 143—Transfer to Institution, \$1,425.77.  
 App. 100, W.O. 243—Transfer to Institution, \$22,282.57.  
 App. 133, W.O. 285—Transfer to Institution, \$9,350.  
 Chap. 488-1921—Power house, equipment and steam distribution system, \$34,000.  
 Pro. 72, W.O. 138—Improvements to steam heating system, \$5,300. Under construction.  
 Pro. 174, W.O. 325—Boiler and breeching, \$17,000. Office work complete.  
 Chap. 318-1921—Removal, disposal and care of bodies, \$7,500; \$7,200. Sketches completed.  
 Chap. 894-1921—Remodeling buildings, furniture and equipment, \$19,095.97.  
 Pro. 153, W.O. 284—Alterations to Manor house, \$6,000. Under construction.  
 App. 101, W.O. 244—Transfer to Institution, \$4,095.79.  
 Institution Contingent Fund:  
 Industrial building, \$20,000. Sketches completed.  
 Blacksmith and paint shop, \$6,000. Sketches completed.

*Norwalk State Hospital.*

Contingent Estimate:  
 Pro. 98, W.O. 184—Telephone System, \$4,300. Completed.  
 Chap. 323-1921—Additional buildings, \$434,000.  
 Pro. 27, W.O. 83—Service connections, \$18,000. Completed.  
 Receiving and treatment building, \$250,000. Working drawings completed.  
 Mortuary, \$2,000. Sketches completed.  
 Pro. 149 W.O. 279—Cottage for male patients, \$60,000. Under construction.  
 Pro. 170, W.O. 322—Cottage for female patients, \$60,000. Office work complete.  
 Pro. 180, W.O. 335—Assistant physician's residence, \$6,700. Office work complete.  
 Chap. 274-1921—Completion of buildings, etc., \$28,000.  
 Pro. 81, W.O. 160—Completion, officers quarters building, \$5,200. Completed.  
 App. 41, W.O. 135—Transfer to Institution, \$1,005.  
 App. 102, W.O. 245—Transfer to Institution, \$21,595.  
 Chap. 275-1921—Additional buildings, etc., \$25,750.  
 Pro. 36, W.O. 86—Farm workers' cottage, \$15,000. Completed.  
 Pro. 37, W.O. 110—Hog farrowing shed, \$3,000. Completed.  
 Pro. 131, W.O. 222—Silo, \$2,100. Under construction.  
 App. 103, W.O. 246—Transfer to institution, \$4,000.

*Pacific Colony.*

- Chap. 445-1921—Buildings, improvements and equipment, \$120,000. Data secured.  
Chap. 884-1921—Furnishings and equipment, \$24,000. Nothing has been done.

*Preston School of Industry.*

- Chap. 907-1921—Repairs, improvements, equipment and furnishing, \$184,900.  
Pro. 21, W.O. 89—Imhoff tank, \$6,000. Under construction.  
Pro. 74, W.O. 102—Completion cottage No. 5 and installation of heat in cottages 3 and 4, \$13,000. Completed.  
Pro. 94, W.O. 173—Hot water storage tank, \$225. Completed.  
Pro. 101, W.O. 179—Repairs to brick plant, \$2,000. Completed.  
Pro. 115, W.O. 197—Repairs and extensions to cold storage plant, \$12,500. Under construction.  
Pro. 158, W.O. 302—Miscellaneous repairs, \$15,000. Under construction.  
Pro. 172, W.O. 323—Improvements, water supply system, \$24,900. Office work complete.  
App. 104, W. O. 247—Transfer to Institution, \$40,000.

*Sacramento State Buildings.*

*State Building Fund:*

- Pro. 69, W.O. 190—Excavation, concrete and piling, structural steel, brick work, granite and terra cotta, \$1,620,288. Under construction.  
Additional work, \$1,379,712. Office work completed.  
Pro. 112, W.O. 190—Water well—drilling, \$550. Office work completed.  
Pro. 132, W.O. 223—Mill and shop inspection, \$1,300. Contract awarded.  
Pro. 132-A, W.O. 237—Mill and shop inspection, \$350. Contract awarded.

*San Diego Mission, San Diego.*

- Chap. 908-1921—Restoration, \$10,000. Nothing has been done.

*San Diego State Teachers College.*

- Chap. 449-1921—Repairs, improvements and equipment, \$84,500.  
Pro. 30, W.O. 7—Alterations to electric work, \$415. Completed.  
Pro. 34, W.O. 8—Painting roof, main building, \$1,000. Completed.  
Pro. 42, W.O. 34—Moving building and repairs, \$525. Completed.  
Pro. 68, W.O. 112—Miscellaneous painting, \$552.95. Completed.  
Pro. 4, W.O. 113—Miscellaneous repairs, \$6,100. Under construction.  
Pro. 82, W.O. 151—Miscellaneous repairs, \$500. Under construction.  
Pro. 127, W.O. 211—Training school building, \$20,000. Under construction.  
Pro. 127-A, W.O. 275—Training school building, \$1,000. Under construction.  
Pro. 128, W.O. 208—Kindergarten and primary building, \$1,700. Under construction.  
Pro. 129, W.O. 212—Remodeling training school building, \$8,000. Under construction.  
Pro. 130, W.O. 213—Alterations to basement, \$4,500. Under construction.  
Pro. 150, W.O. 281—Extension to sewer line, \$2,000. Under construction.  
Pro. 151, W.O. 282—Miscellaneous repairs, main building, \$3,000. Under construction.  
App. 8, W.O. 1—Transfer to Institution, \$1,241.50.  
App. 21, W.O. 2—Transfer to Institution, \$5,000.  
App. 26, W.O. 3—Transfer to Institution, \$10,500.  
App. 27, W.O. 4—Transfer to Institution, \$2,000.  
App. 129, W.O. 271—Transfer to Institution, \$2,000.

*San Francisco State Teachers College, San Francisco.*

- Chap. 280-1921—Purchase of site, new buildings, repairs, improvements and equipment, \$309,512.00.  
App. 61, W.O. 174—Transfer to Institution, \$309,503.54.

*San Jose State Teachers College, San Jose.*

- Chap. 563-1921—Repairs, improvements and equipment, including new well, \$26,500.  
Pro. 8, W.O. 92—Sinking well, equipment, etc., \$10,000. Completed.  
Pro. 46, W.O. 114—Cement walks, graveling, macadamizing, etc., \$2,000. Completed.  
Pro. 66, W.O. 115—Motion picture apparatus, \$1,500. Completed.  
Pro. 121, W.O. 210—Repairs to mechanical equipment, \$4,100. Office work completed.  
App. 62, W.O. 175—Transfer to Institution, \$7,000.  
App. 159, W.O. 316—Transfer to Institution, \$1,200.  
Chap. 389-1921—Manual arts and home economics building, \$205,000.  
Manual arts and home economics building, \$180,000. Working drawing under way.

*San Quentin State Prison, San Quentin.*

- Chap. 738-1921—Cottages for employees, \$15,000.  
Pro. 166, W.O. 301—Eight cottages for employees, \$14,400. Under construction.  
Chap. 566-1921—Repairs, improvements and equipment, \$80,000.  
Pro. 59, W.O. 96—Repairs to roofs, \$4,000. Completed.  
Pro. 59-A, W.O. 168—Repairs to roofs, \$2,637.50. Completed.  
App. 96, W.O. 234—Transfer to Institution, \$73,237.06.  
Chap. 699-1921—Children's hall, \$5,000; \$4,800. Sketches completed.

*Santa Barbara State Teachers College, Santa Barbara.*

- Chap. 387-1921—Repairs, improvements and equipment, \$20,000.  
Pro. 65, W.O. 142—Electrical work, \$7,000. Completed.  
Pro. 124, W.O. 229—Tile roofing, \$1,600. Completed.  
App. 44, W.O. 140—Transfer to Institution, \$5,000.  
App. 124, W.O. 267—Transfer to Institution, \$2,000.  
App. 160, W.O. 313—Transfer to Institution, \$3,500.

*Sonoma State Home.*

- Chap. 390-1921—School and assembly building, \$100,000.  
School, \$22,500. Sketches complete.  
Assembly building, \$74,000. Sketches complete.  
Chap. 319-1921—Cottages, \$71,000.  
Girl's cottage, \$30,000. Working drawings completed.  
Boys cottage, \$20,000. Sketches complete.  
Pro. 136, W.O. 238—Boys cottage at dairy, \$7,500. Completed.  
App. 156, W.O. 315—Transfer to Institution, \$1,755.58.  
Chap. 317-1921—Quarters for employees, \$67,500.  
Quarters for employees—A, \$22,500. Sketches complete.  
Quarters for employees—B, \$26,500. Sketches complete.  
Physician's residence, \$6,500. Sketches complete.  
Chap. 564-1921—Repairs, improvements and equipment, \$127,000.  
Pro. 13, W.O. 118—Trickling filter bed, \$2,338.69\*. Completed.  
Pro. 89, W.O. 165—Cold storage plant, \$21,500. Under construction.  
Pro. 95, W.O. 183—Repairs to plumbing, \$7,716. Under construction.  
Garage, \$8,000. Data secured.  
Pro. 164, W.O. 310—Improvements, two cottages, \$3,000. Under construction.  
Pro. 169, W.O. 312—Improvements to boiler plant, \$1,800. Office work complete.  
Pro. 171, W.O. 319—Reconstructing electrical system, \$25,000. Office work complete.  
Pro. 173, W.O. 324—Extension to conduit lines and heating cottages, \$7,000. Office work complete.  
App. 38, W.O. 116—Transfer to Institution, \$2,000.  
App. 60, W.O. 169—Transfer to Institution, \$16,000.  
App. 105, W.O. 248—Transfer to Institution, \$7,000.

*Southern California State Hospital, Patton.*

- Chap. 439-1921—Housing and training of patients, \$90,000.  
Pro. 5, W.O. 121—Two cottages, R. and S., \$56,000. Under construction.  
Pro. 5-A, W.O. 122—Cottage, \$19,000. Under construction.  
Pro. 147, W.O. 274—Repairs to farm cottage, \$10,000. Under construction.  
App. 92, W.O. 230—Transfer to Institution, \$2,000.  
App. 131, W.O. 280—Transfer to Institution, \$343.25.  
App. 157, W.O. 314—Transfer to Institution, \$1,663.94.  
Chap. 263-1921—Repairs, improvements and equipment, \$45,540.  
Pro. 64, W.O. 124—Septic tank, \$1,500. Completed.  
Pro. 87, W.O. 162—Cold storage plant, \$16,600. Completed.  
Chap. 161, W.O. 278—Residence for assistant physician, \$4,500. Under construction.  
Pro. 168, W.O. 305—Repairs, cottage No. 16—\$1,750. Office work complete.  
App. 106, W.O. 249—Transfer to Institution, \$9,500.

*State Capitol, Sacramento.*

- Chap. 409-1921—Repairs, improvements and alterations to building and grounds, \$8,500.  
Alterations at rear of building, \$2,300. Preliminary work complete.  
App. 84, W.O. 209—Transfer to Department Finance, \$500.  
App. 142, W.O. 296—Transfer to Department Finance, \$369.50.  
App. 146, W.O. 299—Transfer to Department Finance, \$125.  
Chap. 294-1921—Ground lighting system, \$9,200.  
Pro. 144, W.O. 255—Lighting system, \$7,098.46. Completed.  
App. 121, W.O. 256—Transfer to Department Finance, \$2,101.54.

*State Nursery, Near Davis.*

- Chap. 293-1921—Building, \$20,000.  
Pro. 20, W.O. 45—Miscellaneous buildings, \$15,000. Completed.  
Pro. 117, W.O. 189—Lining reservoir and installing pipe, \$4,500. Completed.  
App. 125, W.O. 268—Transfer to Board of Forestry, \$319.41.

*State Printing Office, Sacramento.*

- Chap. 703-1921, 295-1921, 768-1917—Printing Plant, \$138,000. Working drawings under way.

*Stockton State Hospital, Stockton.*

- Chap. 860-1921—Receiving building, \$150,000; \$144,000. Working drawings under way.  
Chap. 393-1921—Repairs, improvements and equipment, \$87,200.  
Pro. 60, W.O. 128—Fuel oil storage, \$3,640. Under construction.  
Pro. 41, W.O. 128—Replacement 2-inch oil line, \$2,400. Completed.  
Pro. 45, W.O. 129—Testing water well, \$1,000. Completed.

\*In addition, the balance of \$2,061.31 remaining in Chap. 380-1919 was used.



- Pro. 70, W.O. 136—Retubing and repairs to boilers, \$6,060. Completed.  
Pro. 71, W.O. 131—Improvements to refrigerating equipment, \$19,560. Completed.  
Pro. 78, W.O. 159—Water lines, \$7,485. Under construction.  
Pro. 84, W.O. 161—Electrical work, \$2,150. Under construction.  
Pro. 71-A, W.O. 164—Addition to W. O. 131, \$1,000. Completed.  
Pro. 119, W.O. 205—Deep well pump, \$6,500. Under construction.  
Pro. 84-A, W.O. 202—Ground lighting, \$800. Office work completed.  
App. 107, W.O. 250—Transfer to Institution, \$24,875.  
Chap. 270-1921—Furnishings and equipment, \$25,000.  
App. 108, W.O. 251—Transfer to Institution, \$25,000.

*Veterans Home, Yountville.*

- Chap. 391-1921—Repairs, improvements, equipment and furnishings, \$79,920.  
Pro. 7, W.O. 11—Pipe line, water lines, repairs to kitchen and two cottages, \$19,900. Under construction.  
Pro. 26, W.O. 12—Hay and calf shed, \$700. Completed.  
Pro. 32, W.O. 13—General repairs, \$20,500. Under construction.  
Pro. 33, W.O. 14—Cement walks, \$500. Completed.  
Pro. 50, W.O. 65—Refrigerating equipment at hospital, \$2,150. Completed.  
Pro. 56, W.O. 66—Repairs to roads, \$2,500. Completed.  
Pro. 56, W.O. 67—Garage, \$600. Completed.  
Pro. 106, W.O. 186—Chicken houses, etc., \$6,210. Under construction.  
Pro. 107, W.O. 187—Repairs to bakery, etc., \$700. Completed.  
Pro. 108, W.O. 188—Repairs to pipe line, \$750. Being done as needed.  
App. 82, W.O. 200—Transfer to Institution, \$1,000.  
App. 15, W.O. 9—Transfer to Institution, \$11,200.  
Chap. 679-1921—Power house, \$40,000.  
Pro. 47, W.O. 201—Addition to building, \$38,400. Under construction.

*Whittier State School, Whittier.*

- Chap. 392-1921—Repairs, improvements, equipment and furnishings, \$198,000.  
Pro. 35, W.O. 131—Building No. 23, \$30,000. Completed.  
Pro. 62, W.O. 132—Repairs and maintenance, \$5,000. Completed.  
Pro. 62-A, W.O. 163—Repairs and maintenance, \$8,000. Under construction.  
Pro. 114, W.O. 196—Boys cottage, \$40,000. Bids being taken.  
Pro. 114-A, W.O. 309—Additional boys cottage, \$40,000. Bids being taken.  
Pro. 133, W.O. 224—Assembly building, \$35,000. Sketches completed.  
App. 88, W.O. 225—Transfer to Institution, \$5,000.  
App. 109, W.O. 252—Transfer to Institution, \$13,000.  
Chap. 446-1921—Water supply, \$33,000.  
Pro. 138, W.O. 239—Drilling water well, \$7,500. Under construction.  
App. 126, W.O. 269—Transfer to Institution, \$8,679.

*Miscellaneous.*

- Department of Agriculture, alterations to Beasley building, Sacramento. Support Fund Department of Agriculture, 905-1921 and Chap. 713-1921.  
Pro. 54, W.O. 58—Diagnostic and bacteriology laboratories, \$2,173. Completed.  
Pro. 54, W.O. 60—Seed inspection laboratory, \$544. Completed.

**SUPPLEMENTARY.**

List of projects handled under appropriations made previous to the 1921 legislature.

*California School for Girls, Ventura.*

- Chap. 584-1919—Completion of cottage unit.  
Pro. 134, W.O. 236—Metal guards, \$500. Under construction.  
Additions to laundry, \$1,837.30—Sketches completed.

*Industrial Farm for Women, Near Sonoma.*

- Chap. 165-1919.  
Pro. 83, W.O. 146—Telephone system, \$1,500. Completed.  
Construction of dam, \$15,000. Completed.  
Pro. 40, W.O. 47—Construction of dam, \$10,000. Completed.  
Repairs to main building, \$23,820. Completed.  
Pro. 111, W.O. 194—Hospital and receiving building, \$35,000. Under construction.

*Napa, State Hospital, Napa.*

- Chap. 565-1919—Quarters for employees.  
Pro. 120, W.O. 218—Additions to superintendent's residence, \$1,750. Under construction.

*Norwalk State Hospital, Norwalk.*

- Chap. 345-1917—Administration building, \$40,000. Completed.  
Chap. 587-1919—Two cottages, \$140,000. Completed.

*Preston School of Industry, Ione.*

- Chap. 400-1919.  
Pro. 85, W.O. 152—Repairing ditch, \$1,000. Completed.  
Pro. 110, W.O. 193—Repairs to electrical system, \$7,000. Under construction.  
Pro. 103, W.O. 192—Miscellaneous repairs, \$2,112.82. Completed.

*San Francisco State Building.*

Chaps. Nos. 541-1913 and 618-1919—Construction of building, \$728,338.94. Under construction.

*Sonoma State Home, Eldridge.*

Chap. 432-1919.

Pro. 12, W.O. 62—Completion of reservoir, \$9,500. Completed.

Chap. 109, W.O. 204—Repairs to springs, \$1,400. Completed.

Pro. 109A, W.O. 216—Repairs to springs, \$950. Completed.

Chap. 139, W.O. 259—Installation of water pipe, \$500. Under construction.

Chap. 154, W.O. 290—Improvements to water supply line, \$2,800. Under construction.

*Veterans Home, Yountville.*

Chap. 483-1917.

Pro. 58, W.O. 68—Boiler, \$4,798. Delivered.

Summary Showing Work Handled by the Division of Architecture, State Department of Public Works, During the Period of Approximately One Year, August 1, 1921, to August 1, 1922.

*Work Completed.*

86 construction projects handled under 1921 appropriations, costing approximately -----	\$434,749 86
11 construction projects handled under previous appropriations, costing approximately -----	245,282 82
	\$680,032 68

*Work Under Construction.*

70 construction projects handled under 1921 appropriations, costing approximately -----	\$712,009 00
9 construction projects handled under previous appropriations, costing approximately -----	3,782,886 94*
	\$4,494,895 94

*Office Work Completed, Construction Not Under Way.*

17 construction projects handled under 1921 appropriations, costing approximately -----	531,150 00
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*Work on Which Sketches Have Been Made or on Which Working Drawings Are Being Prepared.*

24 construction projects handled under 1921 appropriations, costing approximately -----	\$1,067,800 00
1 construction project handled under previous appropriations, costing approximately -----	1,837 30
	\$1,069,637 30

Total ----- \$6,775,715 92

*Transfers.*

Amounts transferred to Institutions for their own use,  
56 items ----- \$768,103 77

The above report indicates that in carrying on the construction work provided for the two-year period by the 1921 legislature, the Division of Architecture completed or has under construction more than half of the projects at the end of the first year. In addition considerable preliminary work has been done on the balance of the program so that when the next special appropriations become available it is reasonable to expect that practically all of the 1921 projects will either be completed or under construction.

Attention is called to the fact that sufficient funds for completion are not now available in connection with the Sacramento State Buildings, San Francisco State Building, and the State Printing Office Building at Sacramento, all of which structures are now in course of construction.

It will be necessary that additional funds for these projects be provided as follows:

1. For the completion of the Sacramento State Buildings the sum of \$900,000.

\*Includes Sacramento and San Francisco State Building Projects.

This additional amount beyond the original bond issue amount of \$3,000,000 is necessary owing to the increased costs of materials and labor as between the time when the \$3,000,000 bond issue was authorized and the present time, the World War having occurred in the meantime. This amount of \$900,000 does not cover the cost of furnishing the buildings.

2. For the completion of the San Francisco State Building the sum of \$135,000.

This additional amount beyond the original amount of the bond issue of \$1,000,000 and the subsequent special appropriation of \$350,000 by the legislature of 1919, is necessary owing to the fact that the special appropriation of \$350,000 made in 1919 was not sufficient to cover the increased costs of materials and labor as between 1914 and the present time. This amount of \$135,000 does not include amounts being turned over to the Department of Public Works by various state agencies to cover the cost of interior partitions, etc., as required to make the several spaces assigned to these particular agencies available for their occupancy. Furthermore, this amount of \$135,000 does not cover the cost of furnishing the building.

3. For the completion of the State Printing Office, the sum of \$85,000.

This additional amount beyond the original appropriations for site and building, totaling \$175,000, is necessary owing to the fact that the amount which remained for building construction after the site was paid for, was insufficient to cover the cost of the permanent fire-resisting building, which it was decided should be erected. This amount of \$85,000 does not cover the cost of machinery, equipment, and furnishings.

#### COST OF OPERATION.

Referring again to the report shown under the heading of "Progress of Work Using Available Funds" we find that during the period from July 30, 1921, to August 1, 1922, the Division of Architecture completed as far as their office work was concerned a total of 190 projects, aggregating in cost \$1,977,739.68, in addition to the Sacramento and the San Francisco State Building projects.

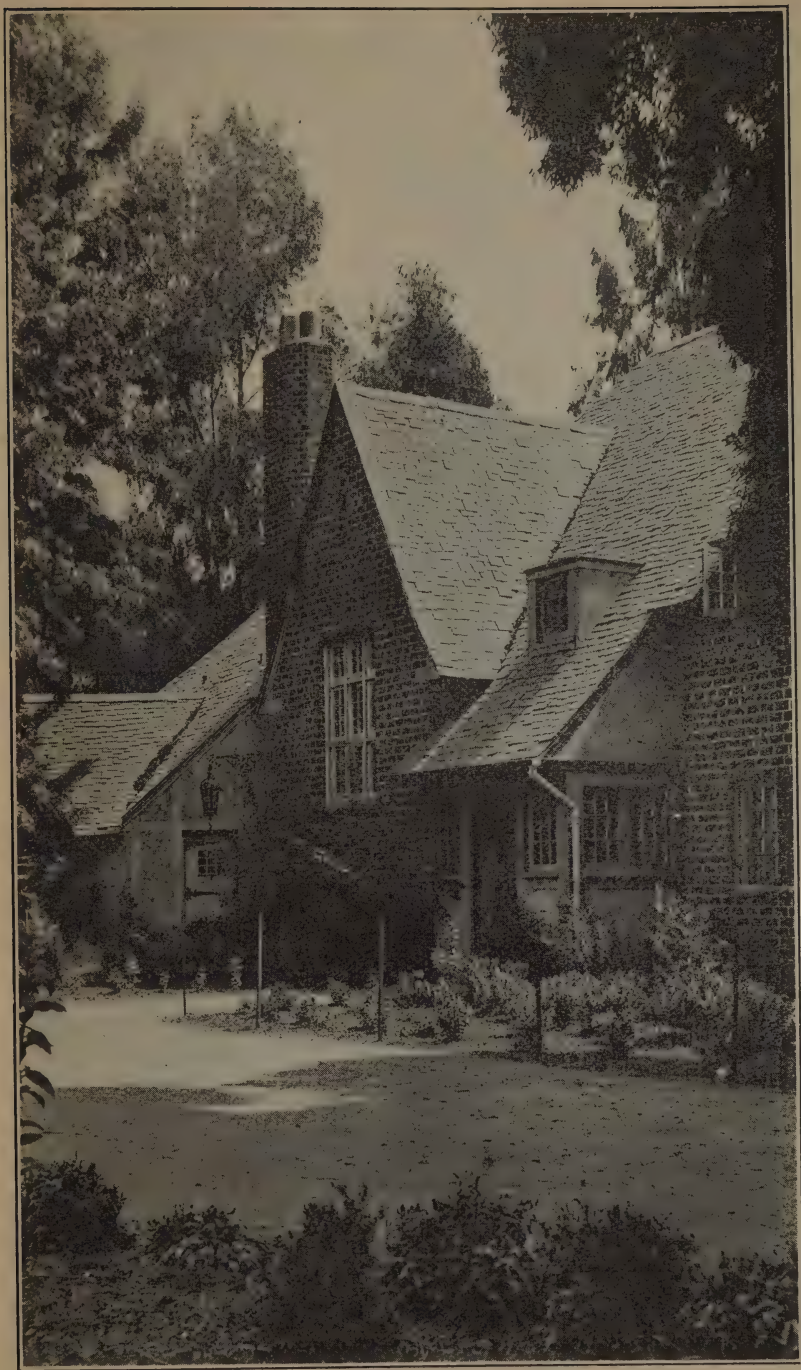
During this same period of time the following expenditures were made from the general appropriation funds at the expense of the Division of Architecture:

Salary Chief of Division.....	\$4,825 81
Salaries auditing, purchasing and janitor.....	15,472 50
Salaries skeleton organization.....	49,281 54
Contingent expenses including traveling, office supplies, equipment, postage, telegrams, expressage, rent, etc. (estimated) .....	20,445 94
Printing (estimated) .....	1,054 87
Total .....	\$71,080 66

As explained under the portion of this report devoted to the operation of the Division of Architecture a considerable amount of time and money is spent by the employees of the Division in handling the miscellaneous activities at the various State institutions; these services rendered being in addition to the work on the actual projects under consideration.

In order to determine the average per cent of cost for architectural services on the 190 projects costing \$1,977,739.68, mentioned above, it is necessary, therefore, to make some deductions from the fixed charges





Superintendent's Residence, Whittier State School, Whittier, California.

indicated above. Some deductions should also be made for the large amount of work involved in carrying on construction work on the Sacramento and San Francisco State Buildings. It is reasonable to assume that at least one-tenth of the auditing, purchasing and janitor expense, and one-third of each of the other four items could be safely charged against these miscellaneous activities and the work on the two main State building operations. Corrected amounts on the above which might, therefore, be rightfully charged against the 190 projects mentioned are as follows:

Salary Chief of Division-----	\$3,217 21
Salaries auditing, purchasing and janitor-----	13,925 25
Salaries skeleton organization-----	33,187 69
Contingent expense -----	13,630 63
Printing -----	703 25
Total -----	\$64,664 03

The total salaries of other employees of the Division including architectural, mechanical, electrical and draftsmen, estimators, etc., while working on these 190 projects, by actual computation were \$39,021.64.

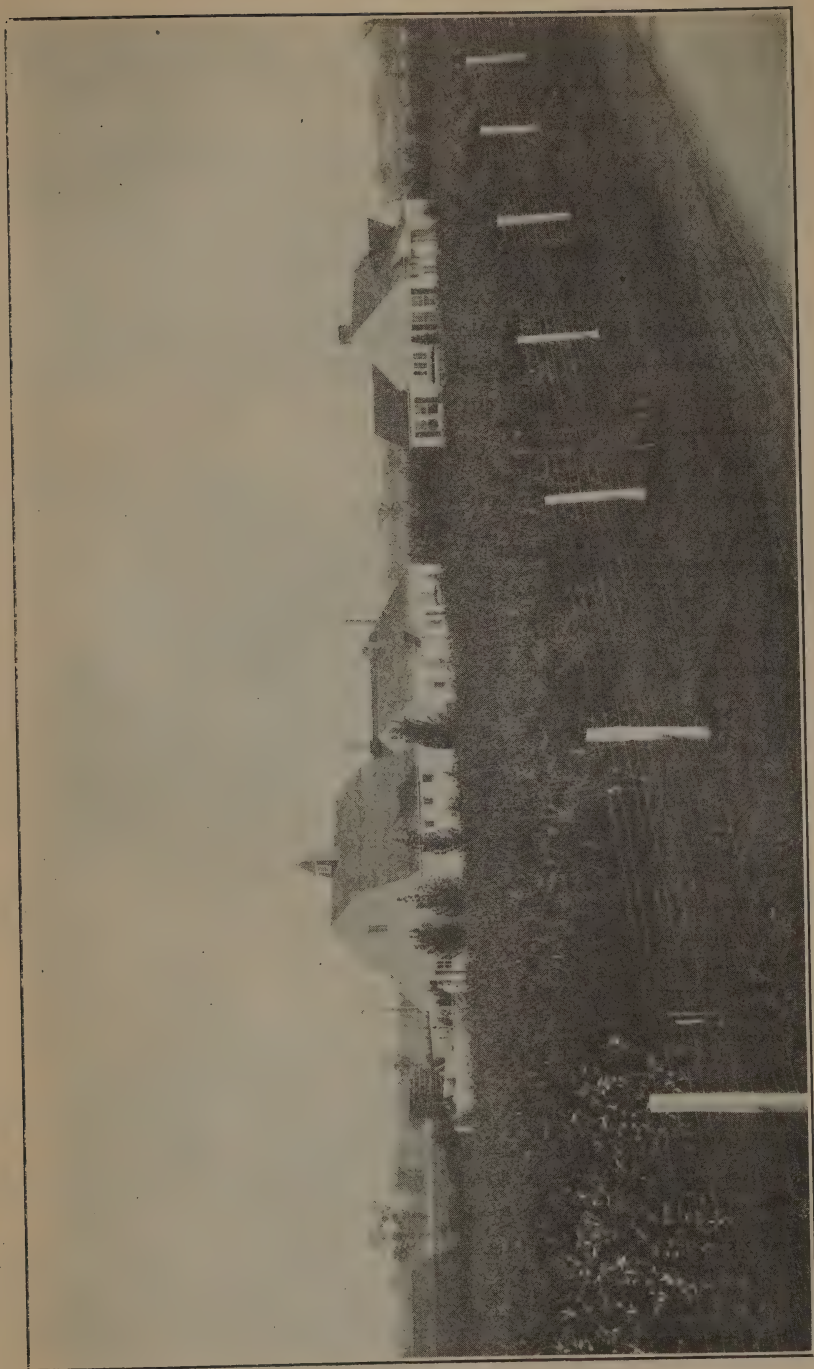
The two amounts given above may be considered as the total expense of the State in handling the projects and in total amount to the sum of \$103,685.65, or approximately 5½ per cent of the total cost for architectural overhead. This percentage might be materially decreased if the actual value of the projects could be estimated and taken into consideration. Due to the fact that a great deal of institution labor has been used in handling these projects the actual value of the completed projects is considerably more than that indicated.

The customary fee for straight architectural services is 6 per cent. At a cost of approximately 5½ per cent to the State the Division of Architecture has rendered on the work considered the usual architectural services and in addition has superintended and built a large percentage of the projects on a basis of day labor, which involves the listing, ordering and delivery of materials, the employment of competent workmen, and considerable cost accounting work. The usual charge for this service by a contractor on a percentage basis is 10 per cent and is in addition to the architect's fee. In addition the Division has maintained an adequate purchasing department, a staff for the testing of materials and an accurate and extensive system of accounts.

#### BENEFITS DERIVED IN MAINTAINING THE DIVISION OF ARCHITECTURE.

In the preceding account on the cost of operation figures were given to show that in maintaining the Division of Architecture the State of California is not only saving a considerable amount of money, but in addition the institutions are given services in addition to those customarily rendered by a practicing architect as well. There are certain other outstanding advantages in maintaining a central architectural office for the handling of all State work as follows:

- (1) Authority and responsibility are centralized and continuous.
- (2) The Division becomes the clearing house of ideas on planning and construction, and every institution gets the benefit of the experiences of all the others.
- (3) All plans of institutional buildings are filed together and are the property of the State. They form an invaluable record, and a library for reference when new buildings are under consideration, that could not be duplicated.



Department of Forestry Propagating Station Near Davis, California.



(4) The personnel of the office naturally becomes expert in planning and designing institutional buildings, which are totally different from the average work encountered by an architect in private practice. They also become acquainted with the individual wishes of the heads of the institutions.

As an index of the attitude of the public toward the quality of the Division's work in architectural design the following article from a newspaper published in Stockton is quoted from the issue of February 15, 1921:

**Gentler Forms of Architecture on State Farm.**

There was a time when Stockton was known, not pleasantly, through the fact that the state hospital was located here. We have outgrown that and have so many other things identified with Stockton that the hospital no longer attracts undue notice from the public at large and small town humorists. A visitor may inquire with some curiosity about the beautiful grounds that surround the tall buildings, but the rest of us are too busy about a multiplicity of affairs to notice even the buildings that of necessity have "institution" written all over them.

But even that unpleasant outward feature is being eliminated in the new type of structure being erected by the State. Out along the lower Sacramento road where the State Farm attached to the hospital is situated, new buildings of pleasing architectural design are going up. Even in the old grounds the buildings in recent years have been on the cottage plan, none being more than two stories high. This conduces not only to greater comfort and convenience by eliminating stairways, is less dangerous in case of fire, but tends to take away as much as possible the suggestion of an institution. Along with discarding the harsh, ugly name by which such a place was known and calling it a state hospital, modern thought seeks to soften also, its outward features as much as possible.

Strangers driving by the state farm would get the impression from the light, cheerful, comparatively low buildings of somewhat English design under the spreading oaks that they were passing some private estate. Or they might get the idea of the beginning of a group of college buildings on a spacious campus. Possibly in time all the state hospital buildings will be located in the country. With the farming and dairying features connected with it, the world will more than ever get a feeling, perhaps, that this is the well kept home of our unfortunate brothers and sisters. And, largely through the adoption of gentler forms—if one may use that expression—of architecture.

In addition the following letter was received recently from Mr. William B. Faville, a practicing architect of the city of San Francisco, and at this writing, president of the American Institute of Architects:

September 26, 1922.

Mr. Geo. B. McDougall,  
Division of Architecture,  
Department of Public Works,  
Sacramento, Calif.

MY DEAR MCDUGALL:

May I express to you my pleasure in serving on the Examining Board of the Civil Service Commission, which has at various times passed upon applicants for positions in the Architectural Department of the State.

The excellency of the work which the Architectural Department under your guidance has produced warrants more than a word of praise both as to quality of its design and execution.

The thoroughness of the various departments with which I have become familiar leads me to believe that any draftsman spending a few years in the State Architect's office, will find it of great benefit for his general development. The seriousness and exactness of your work as well as the opportunity offered by the wide range of creative design with which your office is constantly filled, should prove of sound advantage to him.

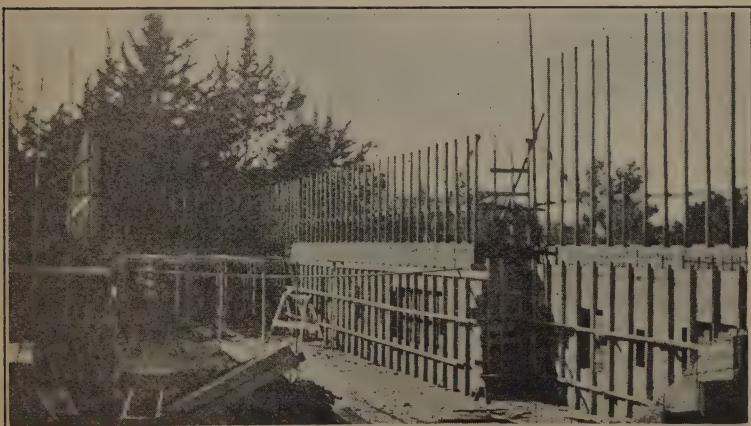
Very truly yours,  
BLISS & FAVILLE,  
(Signed) By W. B. Faville.



Warehouse and Auto Shop Building, California Polytechnic School,  
San Luis Obispo, California.



Horse Barn Under Construction, California Polytechnic School, San Luis  
Obispo, California.



Workers' Cottage, Napa State Hospital, Napa, California.  
Under Construction October 21, 1922.

(5) There is no desire to minimize the study on any given problem, because of considerations of profit.

(6) A much more intelligent and regular development of new institutions is possible, than could obtain where outside architects and engineers were employed, and constantly changed.

(7) There would always be dissatisfaction among the architects and engineers who were not favored with state work. It would not be fair to give all the work to a few firms, nor would it be to the advantage of the State to be constantly changing. This is a problem that would never be settled to the satisfaction of all concerned.

(8) The large mass of alterations, repairs, etc., so small in value that they could not be turned over to experts, would not receive the attention they now do.

No private architect has the facilities for testing materials of all kinds which the State carries in connection with the Department of Public Works. This testing department makes possible a large saving in the prevention of inferior substitutes in building materials.

The materialmen of the State are entitled to impartial treatment in the matter of opportunity to sell their materials for public work. This condition would not fully prevail under the customary practice of private architects and engineers, and is only made possible through the present Division and its Purchasing Department.

#### RECOMMENDATIONS.

The State of California, through the services of this Division, is obtaining a high standard of excellence in all its buildings and mechanical installations from the standpoint of design, and figures show that this is being done economically.

There are two vital points, however, in connection with the work that must be constantly kept in mind in order that the construction work of the Division of Architecture may be properly carried forward. These two points are, first, that all construction projects should be carefully estimated and properly financed; second, that the State adopt a policy of permanent building construction at all institutions where same is considered advisable.

Legislatures previous to 1921 in making appropriations for building construction had followed the policy of extreme itemization as to particular work to be done and separate amounts for separate pieces of work. This policy produced an inelasticity in the expenditure of funds for building construction that was a distinct handicap in securing best results. The 1921 legislature in a large degree changed this policy by making lump sum appropriations for building construction at the various institutions. This change has removed the difficulty, which in some cases created an impossible condition growing out of the necessity under the earlier policy of making each particular piece of work fit the special amount of money set aside for it at a time when full information necessary could not be available. The Budget Board in considering requests for appropriations for building construction to be presented to the 1921 legislature, in a larger degree than previous Budget Boards secured the assistance of the Division of Architecture in the preparation of estimates of costs, rather than arriving at amounts



without sufficient technical information. The results in the actual execution of the work provided for by the legislature have been very satisfactory.

To a certain extent the policy in connection with construction work in this State in the past has been to keep first cost at a minimum by using inferior materials, principally in the shape of wood frame construction. Most of these structures are used to house inmates at the various institutions, and where this policy has been adopted it has been the somewhat natural outgrowth of the present necessity for rapid increase in accommodations. In these cases the real economy of good building is ignored and instead of a steady permanent growth the institutions affected are being developed in a way that will demand reconstruction within a comparatively few years.

When all the points in connection with the construction of a state institution are considered and carefully analyzed it will be found that there is no saving effected in the long run by the use of wood frame construction. Where inmates are housed behind locked doors and barred windows and the buildings are of wood frame construction, prudence demands that they be only one story high. This policy is never varied from in the Division of Architecture. The area covered, therefore, is practically twice as great as for a two-story building of equal capacity, and in addition it is necessary that such buildings be placed farther apart because of the risks of a general conflagration; the total area of ground required is easily twice as great as for the non-combustible type of construction.

This increased area affects the total area required for the institution, the cost of all service connections to buildings, such as sewer, steam, gas, water, electricity, etc., as well as increasing the cost of administration. Furthermore, the difference between a fire-resisting and a wood frame building is largely in the rough shell. It is necessary to use practically the same grade and amount of interior finish, doors, windows, floors, painting, hardware, heating, plumbing, electrical work, etc., in each type. The result is that the first cost of fire-resisting buildings is largely only from 20 to 25 per cent greater than of the cheaper type, while its life is easily double that of a wood frame structure. Furthermore, the cost of upkeep of the non-combustible building is much less than the other so that it is probable that if the total expenditure for first cost and upkeep of a wood frame building taken over a period of twenty years were compared with the first cost of a fire-resisting building including its upkeep for twenty years there would be practically no difference in total amount.

Fires are occurring more or less frequently in state structures and if the policy of using wood frame construction for permanent buildings is not entirely abandoned there is great danger of a rude awakening to the error in following such policy occasioned by a conflagration causing the loss of many thousands of dollars worth of property, or worse than that the loss of the lives of inmates locked within the inflammable walls.



Hospital Building, Industrial Farm for Women, Near Sonoma.  
Under Construction October 21, 1922.



Guards' Cottages, California State Prison, San Quentin, California.  
Under Construction October 20, 1922.

**FINANCIAL STATEMENT, DEPARTMENT OF PUBLIC WORKS.  
DIVISION OF ARCHITECTURE.**

Chapter and year	Name of job	Balance July 29, 1921, and appro- priations	Expended	Balance June 30, 1922
	<b>STATE AGRICULTURAL SOCIETY.</b>			
	<i>Agricultural Park.</i>			
296-1921	Repairs, buildings and grounds.....	\$10,000 00	\$22,764 51	\$17,235 15
572-1919	Repairs, buildings and grounds.....	1 24	1 24	
202-1915	Women's building .....	2 82	1 76	1 06
591-1919	Improvement to grounds.....	51 20	39 60	11 60
		\$10,055 26	\$22,807 41	\$17,247 85
	<b>THE ADJUTANT GENERAL'S OFFICE.</b>			
	<i>Armories.</i>			
310-1917	San Diego repairs.....	\$800 00		\$800 00
	<b>DEPARTMENT OF INSTITUTIONS.</b>			
	<i>Industrial Farm for Women.</i>			
254-1921	Additions and improvements.....	\$24,000 00	\$432 83	\$23,567 17
	Credits .....	39,639 30		
165-1919	Building repairs, etc.....	22,608 22	37,079 35	25,168 17
		\$86,247 52	\$37,512 18	\$48,735 34
	<i>Industrial Home for the Adult Blind.</i>			
397-1921	Repairs, etc. ....	\$12,500 00	\$5,763 05	\$6,733 95
637-1921	Buildings, etc. ....	76,300 00	825 96	75,474 04
446-1919	Repairs, etc. ....	3 80		3 80
288-1917	Improvements to grounds.....	13 54		13 54
289-1917	Water supply .....	211 18	137 88	73 30
645-1919 Res. 51	Fuel-burning equipment .....	778 70	778 70	
		\$89,807 22	\$7,508 59	\$82,298 63
	<i>Sonoma State Home.</i>			
564-1921	Repairs, etc. ....	\$127,000 00	\$35,572 85	\$91,427 15
317-1921	Quarters for officers and employees.....	67,500 00	20 05	67,479 95
319-1921	Cottages .....	71,000 00	82 00	70,168 00
390-1921	School and assembly building.....	100,000 00	94 31	99,905 69
624-1919	Cottage .....	3 06		3 06
380-1919	Sewers and drains.....	5 31		5 31
432-1919	Water supply .....	48,120 34	10,256 94	37,863 40
351-1917	Steam pipes .....	13 06		13 06
353-1917	Commissary .....	56 14		56 14
Cont. est. #7678	Switch board .....	210 25	210 25	
		\$413,908 16	\$46,986 40	\$366,921 76
	<i>Pacific Colony.</i>			
445-1921	Buildings, etc. ....	\$120,000 00	\$3 42	\$119,996 58
776-1917	Buildings, etc. ....	1,411 72	1,411 72	
776-1917	Pole line .....	631 66	661 66	
	Credits .....	343 50		
562-1919	Buildings .....	1,369 47	6 75	1,706 22
		\$123,786 35	\$2,083 55	\$121,702 80
	<i>Agnews State Hospital.</i>			
253-1921	Repairs, etc. ....	\$53,500 00	\$16,297 15	\$37,202 85
252-1921	Buildings and purchase dairy herd.....	25,000 00		25,000 00
881-1921	Quarters for employees.....	100,000 00		100,000 00
568-1919	Cottage .....	4,412 63	2,669 86	1,742 77
402-1919	Heating system .....	491 03	462 54	28 49
307-1917	Cottage .....	3 01		3 01
332-1917	Cottage .....	15 78		15 78
754-1915	Cottage .....	327 90	327 90	
		\$183,750 35	\$19,757 45	\$163,992 90



**Financial Statement, Department of Public Works,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance July 29, 1921, and appropriations	Expended	Balance June 30, 1922
<i>Mendocino State Hospital.</i>				
256-1921	Water supply -----	\$25 000 00	\$1 50	\$24,998 50
255-1921	Repairs, etc. -----	62,660 00	21,821 62	40,838 38
399-1921	Receiving building -----	150 000 00	50 59	149,949 41
905-1921 Res. #5	Repairs main building -----	20,000 00	19,894 34	105 66
404-1919	Sundry improvements -----	24 62	-----	24 62
447-1919	Heating system -----	7 97	-----	7 97
444-1919	Shelters -----	25 46	-----	25 46
267-1917	Water softening -----	2 11	-----	2 11
325-1917	Plumbing repairs -----	7 14	-----	7 14
326-1917	Operating room -----	33 37	-----	33 37
377-1917	Reconstruction Ward 10 -----	3 42	-----	3 42
371-1917	Repairs -----	13 45	-----	13 45
Cont. est. #1058	Lighting system -----	2,175 21	-----	2,175 21
Cont. fund	Alterations Wards Nos. 1 and 2 -----	12,000 00	7 08 82	4 921 33
Cont. fund	Brick plant -----	10,000 00	1,965 89	8,034 11
107-1913	Dam and reservoir -----	50 00	50 00	-----
Cont. fund	Plumbing and electrical work -----	2,600 00	-----	2,600 00
		\$28,460 75	\$50,852 56	\$233,750 19
<i>Napa State Hospital.</i>				
318-1921	Removal and disposal of bodies -----	\$7,500 00	-----	\$7,500 00
894-1921	Remodeling buildings, etc. -----	19 095 79	-----	19 095 79
447-1921	Repairs, etc. -----	95 000 00	53 341 35	41 658 65
448-1921	Power house, etc. -----	34,000 00	2 047 99	31 952 01
859-1921	Cottage -----	100,000 00	2 406 84	97 593 16
739-1921	General improvements -----	25 000 00	16,314 66	8,685 34
	Credit -----	1,950 00	1,734 81	1,460 16
565-1919	Quarters for employees -----	1,944 97	-----	-----
597-1919	Heating system -----	1,346 80	-----	1,346 80
399-1917	Sewer -----	7 66	-----	7 66
480-1917	Two cottages -----	6 19	-----	6 19
789-1917	Water supply -----	280 35	277 73	2 62
Cont. est. #176	Rewiring superintendent's residence -----	29 84	22 65	7 19
487-1913	Dairy building -----	441 51	441 51	-----
486-1913	Dormitories -----	284 12	284 12	-----
		\$286,187 23	\$76,871 66	\$209,315 57
<i>Norwalk State Hospital.</i>				
275-1921	Buildings -----	\$25 750 00	\$21 903 41	\$4 546 59
274-1921	Building completion -----	28 000 00	27,715 23	284 74
393-1921	Buildings, etc. -----	434,000 00	19,195 94	414,804 06
588-1919	Officers quarters -----	16 27	15 73	45
587-1919	Two cottages -----	48,609 05	38 614 74	9 995 22
345-1917	Administration building -----	29 803 95	27,038 29	2,764 69
589-1919	Improvements on farm -----	53 27	48 25	5 02
585-1919	Water tower, etc. -----	3,713 63	96 22	3,617 43
343-1917	Superintendent's residence -----	5 53	-----	5 53
	Credits -----	138 84	133 79	30 33
347-1917	Farm buildings -----	95 92	-----	-----
433-1919	Farm buildings, completion -----	63 98	3 06	65 92
Cont.	Telephone system -----	4,400 00	3,351 88	1,048 12
		\$574,585 03	\$137,416 60	\$437,168 43
<i>Southern California State Hospital.</i>				
263-1921	Repairs, etc. -----	\$45 540 00	\$18,463 43	\$27 071 57
439-1921	Housing and training of patients -----	90,000 00	67,334 74	22,665 26
440-1919	Heating plant -----	1,239 63	337 38	902 25
336-1917	Boiler -----	9 39	-----	9 39
338-1917	Cottage No. 17 -----	4 13	-----	4 13
389-1917	Pump and motor -----	8 85	-----	8 85
404-1917	Nurses home -----	147 47	137 98	9 54
Cont. est. #217	Deep well pump -----	875 39	875 39	-----
281-1911	Power plant -----	107 70	107 70	-----
		\$137,932 56	\$87,261 57	\$50,670 99

Financial Statement, Department of Public Works,  
Division of Architecture—Continued.

Chapter and year	Name of job	Balance July 29, 1921, and appropriations	Expended	Balance June 30, 1922
<i>Stockton State Hospital.</i>				
393-1921	Repairs, etc.-----	\$87,200 00	\$52,805 49	\$34,394 51
860-1921	Receiving and psychopathic building-----	150,000 00		150,000 00
601-1919	Cottage on farm-----	4 94	3 46	1 48
398-1919	Sewer system-----	14,254 48		14,254 48
272-1917	Tubercular hospital-----	5 19		5 19
330-1917	Cottage-----	6 36		6 36
		\$251,470 97	\$52,808 95	\$198,662 02
<i>California School for Girls.</i>				
265-1921	Repairs, etc.-----	\$45,500 00	\$21,787 59	\$23,712 41
266-1921	Water supply-----	11,000 00	9 30	10,990 70
367-1917	Three cottages-----	212 63		212 63
365-1917	Heating system-----	14 21		14 21
366-1917	Grounds improvement-----	98 51	97 30	1 21
474-1917	Water system-----	6 04	1 65	4 36
388-1919	Cottages-----	55,961 11		55,961 11
389-1919	Farm buildings-----	49 70		49 70
569-1919	Ground improvement-----	9 46		9 46
584-1919	Cottage unit completion-----	2,381 53	44 23	2,337 30
		\$115,283 19	\$21,940 10	\$93,293 09
<i>Preston School of Industry.</i>				
907-1921	Repairs, etc.-----	\$184,900 00	\$57,511 64	\$127,388 36
400-1919	Repairs, etc.-----	19,681 51	12,086 96	7,594 55
		\$204,581 91	\$69,598 60	\$134,983 31
<i>Whittier State School.</i>				
392-1921	Repairs, etc.-----	\$198,000 00	\$46,181 02	\$151,818 98
446-1921	Water supply-----	33,000 00	8,738 91	24,261 09
590-1919	Repairs-----	444 55	444 55	
629-1919	Buildings, etc.-----	680 72	680 72	
355-1917	Power house-----	4 47		4 47
356-1917	Buildings, etc.-----	13 36	13 36	
357-1917	Repairs-----	1 27	1 27	
Cont. est. #4837	Buildings, etc.-----	190 75	84 22	106 53
		\$232,335 12	\$56,144 05	\$176,191 07
DEPARTMENT OF EDUCATION.				
<i>California Polytechnic School.</i>				
440-1921	Repairs, etc.-----	\$91,800 00	\$43,299 30	\$48,500 70
315-1917	Barn-----	3,995 00	977 78	3,017 22
471-1917	Repairs-----	16 40	9 00	7 40
445-1919	Repairs-----	29 65		29 65
		\$95,841 05	\$44,286 08	\$51,554 97
<i>California School for the Deaf and the Blind.</i>				
261-1921	Repairs, etc.-----	\$25,000 00	\$5,057 19	\$19,942 81
293-1917	Heating system-----	2,191 53	1,632 33	559 20
294-1917	Electric wiring-----	3 75		3 75
348-1917	Repairs-----	50	50	
277-1915	Heating system-----	102 32	102 32	
905-1921 Res. #9	Repairs-----	23 96	23 96	
615-1919				
Emerg. res. #11	Repairs-----	23 96	23 96	
		\$27,346 02	\$6,840 26	\$20,505 76
<i>Chico State Teachers College.</i>				
136-1911	Passage way-----	\$24 84	\$24 82	
282-1917	Addition to training building-----	77 28		\$77 28
559-1919	Trades school unit-----	384 01	28 03	355 98
558-1919	Repairs-----	134 34	52 38	81 96
557-1919	Water supply-----	52 97	13 53	39 44
224-1915	Repairs-----	55 73	55 08	65
459-1913	Water supply-----	20 39	20 37	02
536-1913	Street work-----	75 70	74 74	96
		\$825 26	\$268 97	\$556 29

**Financial Statement, Department of Public Works,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance July 29, 1921, and appropriations	Expended	Balance June 30, 1922
	<i>Fresno State Teachers College.</i>			
436-1919	Repairs -----	\$4 52		\$4 52
240-1917	Plant equipment -----	17 94		17 94
303-1917	For payment of claims of contractors-----	9,107 32		9,107 32
441-1921	Improvements to street and grounds-----	20,000 00	\$20,000 00	
		\$29,129 78	\$20,000 00	\$9,129 78
	<i>Humboldt State Teachers College.</i>			
565-1921	Completion buildings -----	\$33,200 00	\$33,056 33	\$143 67
408-1919	Painting -----	90 89	90 89	
743-1917	Buildings -----	3,990 11	3,990 11	
		\$37,281 00	\$37,137 33	\$143 67
	<i>San Diego State Teachers College.</i>			
449-1921	Repairs, etc. -----	\$84,500 00	\$30,963 39	\$53,536 61
246-1917	Improvement of grounds-----	2 43		2 43
461-1919	Improvement of grounds-----	9 48		9 48
308-1917	Street paving -----	1,469 56		1,469 56
		\$85,981 47	\$30,963 39	\$55,018 08
	<i>San Francisco State Teachers College.</i>			
280-1921	Purchase of site and buildings-----	\$309,512 00	\$309,512 00	
	<i>San Jose State Teachers College.</i>			
563-1921	Repairs, etc. -----	\$26,500 00	\$17,653 40	\$8,846 60
389-1921	Manual arts building-----	205,000 00	177 77	204,822 23
258-1917	Assembly hall -----	4 58		4 58
391-1919	Heating plant -----	73 83		73 83
476-1919	Repairs and improvements-----	45 15		45 15
Cont. est. #9370	Repairs to telephone system-----	7 59		7 59
		\$231,631 15	\$17,831 17	\$213,799 98
	<i>Santa Barbara State Teachers College.</i>			
387-1921	Repairs, etc. -----	\$20,000 00	\$12,856 44	\$7,143 56
451-1919	Repairs, etc. -----	18 17	18 17	
257-1917	Gymnasium -----	13 21	13 21	
250-1917	Sewer system -----	20 03		20 03
		\$20,051 41	\$12,887 82	\$7,163 59
	STATE BOARD OF PRISON DIRECTORS. STATE PRISONS.			
	<i>California State Prison, Folsom.</i>			
680-1921	Five cottages -----	\$15,000 00	\$12,719 16	\$2,280 84
394-1921	Repairs, etc. -----	52,000 00	35,639 82	16,360 18
396-1919	Electric installation -----	759 51	563 82	195 69
	Credit -----	155 60		
467-1919	Repairs -----	184 54	115 18	224 96
276-1917	School building -----	517 75	367 82	149 93
278-1917	Repairs -----	6 29		6 29
485-1917	Boilers -----	9 00		9 00
492-1919	Machine and blacksmith shop-----	1,279 05		1,279 05
273-1915	Cells, etc. -----	240 86	240 86	
		\$70,152 60	\$49,646 66	\$20,505 94



**Financial Statement, Department of Public Works,  
Division of Architecture—Concluded.**

Chapter and year	Name of job	Balance July 29, 1921, and appropriations	Expended	Balance June 30, 1922
<i>California State Prison, San Quentin.</i>				
699-1921	Children's hall -----	\$5,000 00	\$1 50	\$4,998 50
576-1921	Repairs -----	80,000 00	80,000 00	-----
738-1921	Employees cottages -----	15,000 00	-----	15,000 00
401-1919	Electrical installation -----	551 58	58 03	493 55
233-1917	Rewiring -----	40 58	-----	40 58
257-1917	Rewiring -----	1 99	1 50	49
284-1917	Small building -----	11 97	-----	11 97
285-1917	Farm buildings -----	5,000 00	-----	5,000 00
		\$105,606 12	\$80,061 03	\$25,545 09
<i>Veterans' Home of California.</i>				
679-1921	Power house -----	\$40,000 00	\$2,691 46	\$37,308 54
391-1921	Repairs, etc. -----	79,200 00	45,732 32	33,467 68
442-1919	Repairs, etc. -----	142 58	-----	142 58
483-1917	Boilers -----	5,062 47	248 18	4,798 29
391-1917	Electric wiring -----	22 51	-----	22 51
905-1921	-----	-----	-----	-----
Emer. res. #3	Repairs to kitchen -----	2,000 00	1,988 94	16 06
426-1917	Hospital kitchen -----	7 23	-----	7 23
244-1917	Painting buildings -----	3 06	-----	3 06
263-1917	Repairs -----	5 43	-----	5 43
243-1917	Tubercular ward -----	5 39	-----	5 39
236-1911	Fire escapes -----	255 63	255 63	-----
645-1919	-----	-----	-----	-----
Emer. res. #68	Repairs to kitchen -----	1,789 25	1,789 25	-----
470-1913	Pipe line -----	2 77	2 77	-----
		\$128,496 32	\$52,719 55	\$75,776 77
<i>MISCELLANEOUS.</i>				
368-1917	State Capitol, painting -----	\$28 85	-----	\$28 85
409-1921	State Capitol, repairs -----	8,500 00	\$12 57	8,487 43
Fund	San Francisco state building -----	378,338 94	251,987 67	126,351 27
618-1917	San Francisco state building -----	350,000 00	188,592 87	211,407 13
Fund	Sacramento state building -----	2,864,537 85	29,644 74	2,834,893 11
703-1921	State printing office -----	75,000 00	32,060 86	42,939 14
762-1917	State printing office -----	100,000 00	-----	100,000 00
293-1921	State nursery, Davis -----	20,000 00	18,900 17	1,099 83
475-1917	State nursery, Davis -----	2,114 67	2,077 01	37 66
430-1917	Secretary of State, office vault -----	687 30	55 00	632 30
Fund	Fish and Game Commission, Lake Tahoe hatchery -----	64 49	-----	64 49
Fund	Fish and Game Commission, building San Pedro -----	26,642 45	26,607 45	35 00
387-1919	Marshall shop -----	12 85	10 75	2 10
400-1917	Marshall monument -----	3 92	-----	3 92
321-1917	Monterey custom house -----	186 85	-----	186 85
311-1917	Fort Ross repairs -----	1,053 28	697 00	356 28
910-1921	Mission San Francisco De Solano Sonoma -----	1,000 00	27 65	972 35
480-1913	Mission San Francisco De Solano Sonoma -----	95 03	44 47	50 56
322-1911	Mission San Francisco De Solano Sonoma -----	28 28	7 50	20 78
908-1921	Mission San Diego restoration -----	10,000 00	-----	10,000 00
430-1921	Panama-California Exposition Building -----	10,000 00	-----	10,000 00
419-1921	California Redwood Park, repairs -----	25,000 00	12,951 60	12,048 40
871-1921	Humboldt Redwood Park, administration building, etc. -----	9,000 00	5,598 81	3,401 19
905-1921	Alterations offices, Department of Agriculture, support -----	2,593 00	2,593 00	-----
713-1921	Alterations office, Department of Agriculture, seed inspection -----	600 00	600 00	-----
905-1921	Contingent expense, seventy-third year -----	18,333 83	15,451 23	2,882 10
905-1921	Contingent expense, seventy-fourth year -----	20,000 00	-----	20,000 00
905-1921	Printing, seventy-third year -----	2,000 00	1,422 92	577 08
905-1921	Printing, seventy-fourth year -----	2,000 00	-----	2,000 00
905-1921	General appropriation, salaries seventy-third year -----	61,742 98	57,869 08	3,873 90
905-1921	General appropriation, salaries seventy-fourth year -----	66,016 00	-----	66,016 00
905-1921	General appropriation, compensation seventy-third year -----	300 00	272 68	27 32
		\$8,223,017 87	\$1,949,188 96	\$6,273,828 91

## APPENDIX.

### BUREAU OF ARCHITECTURE.

The activities of the Bureau of Architecture since November 1, 1920, the date of the last biennial report, are given in the following summary:

#### ASSISTANCE RENDERED IN THE PREPARATION OF THE 1921 BUDGET.

Through the fall of 1920 and during the spring of 1921, members of this Bureau made trips to various State institutions and agencies, giving information, advice and collecting data to assist in the 1921 budget. Sketches and layouts were made and careful estimates prepared for the consideration of the Budget Board. A representative of the Bureau was present at all of the Budget hearings, explaining estimates and submitting sketches. Assistance was also given the Budget Board after the hearings in determining the proper amounts to be allowed by this Board.

#### PRELIMINARY WORK ON NEW APPROPRIATIONS.

During the past two or three months, considerable time has been taken in gathering preliminary data to assist in the preparation of drawings for work provided by the 1921 legislature. This data has been collected at the time of our regular inspection trips so that when the new funds become available, this Bureau may proceed with the detailed drawings and construction work as rapidly as possible where needed.

#### COMPLETION OF PROJECTS PROVIDED FOR BY THE 1919 LEGISLATURE.

The Bureau has been successful in completing practically all the construction items provided for by the legislature of 1919. There are some few, however, which have been delayed by circumstances over which this Department has no control. Construction work is still being carried on at the Norwalk State Hospital and at the Industrial Farm for Women, with 1919 funds. These projects, however, are being rushed to completion and should be finished within two or three months.

Unfortunately, our operations on the San Francisco State Building are being delayed by the labor difficulties existing there.

The only other unfinished projects of any consequence are the Sacramento State Buildings and the new State Printing Plant, on which nothing can be done at present.

#### NEW PROJECTS COMPLETED AND UNDER CONSTRUCTION.

In addition to work provided for by the 1919 legislature, we have been called upon to handle several minor operations for different institutions and agencies, the cost of these operations being met by the institutions from funds other than those appropriated; for example, repairs are now under way at the Mendocino State Hospital and at the Veterans' Home on buildings recently damaged by fires, the cost of these repairs being met by the Board of Control Emergency Fund.

Repairs and new construction work is also being handled for the Adjutant General from the National Guard Support Fund and a labora-

tory and office building are under construction at San Pedro at an estimated cost of \$29,000 for the Fish and Game Commission.

Alterations are now being made to the building at Tenth and R streets, which is to house the Motor Vehicle Department and the Bureau of Criminal Identification.

The following summary shows the status of work handled by the Bureau of Architecture for the State Department of Engineering at the close of the biennium:

126 items entirely or practically completed, costing	\$1,452,262 15
12 items on which office work is completed and construction under way, costing	1,654,752 00
*3 items on which office work is completed but construction not yet started, costing	3,523,000 00
*1 item on which preliminary work is completed, costing	40,000 00
*3 items on which nothing has been done, costing	135,000 00
Total 145 items	\$6,805,014 15

GEORGE B. McDougall,  
State Architect.

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\*All of these items are being delayed by circumstances over which this Department has no control.



**FINANCIAL STATEMENT, DEPARTMENT OF ENGINEERING.  
DIVISION OF ARCHITECTURE.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
	<b>STATE AGRICULTURAL SOCIETY.</b>			
	<i>Agricultural Park.</i>			
572-1919	Repairs to building and equipment.....	\$3,011 87	\$3,010 63	\$1 24
591-1919	Improvements of grounds.....	6,433 58	6,421 98	11 60
512-1913	Drainage and sewers.....	9 30	9 30	
534-1911	Dairy buildings and barns.....	7 84	7 84	
280-1917	Construction and repairs to buildings.....	7 80	7 80	
775-1917	Construction agricultural pavilion.....	5 46	5 46	
		\$9,475 85	\$9,463 01	\$12 84
	<b>THE ADJUTANT GENERAL'S OFFICE.</b>			
	<i>Armories.</i>			
468-1913	Armory, Los Angeles.....	\$502 27	\$374 55	\$127 72
460-1913	Armory, Sacramento.....	17 21		17 21
258-1915	Armory, Naval Militia, San Diego.....	306 18		306 18
310-1917	Armory, Naval Militia, San Diego.....	800 00		800 00
321-1915	Armory, Stockton.....	106 02		106 02
549-1913	Armory, San Francisco.....	7,500 00	6,790 00	710 00
		\$9,231 68	\$7,164 55	\$2,067 13
	<b>SCHOOLS.</b>			
	<i>California Polytechnic School.</i>			
315-1917	Construction of barn.....	\$3,995 00		\$3,995 00
511-1900	Construction of barn.....	22		22
207-1911	Dining hall.....	96 64	\$96 64	
271-1911	Heating system.....	4 81	4 46	35
493-1913	Heating system.....	10 00	10 00	
270-1911	Power, heat and light.....	21		21
291-1915	Repairs to building.....	5 48	1 92	3 56
548-1911	Repairs and improvements.....	2 63		2 63
492-1913	Repairs to buildings.....	143 62	143 62	
471-1917	Repairs to buildings.....	16 40		16 40
102-1913	Water system.....	293 46	229 32	64 14
290-1915	Water supply.....	144 37		144 37
228-1911	Water and sewer system.....	1 19		1 19
358-1917	Repairs, emergency fund.....	5 35	5 35	
445-1919	Repairs, improvements and equipment.....	29 65		29 65
		\$4,749 08	\$491 31	\$4,257 72
	<i>Chico State Normal.</i>			
173-1913	Repairs and additions to heating system.....	\$79 07		\$79 07
224-1915	Repairs and improvements.....	55 73		55 73
460-1913	Repairs and alterations.....	76		76
282-1917	Additions to training building.....	239 11	\$161 83	77 28
459-1913	Water supply.....	20 39		20 39
136-1911	Passageway.....	25 31		25 21
536-1913	Street work.....	75 70		75 70
559-1919	Trade school unit.....	24,511 68	24,127 67	384 01
558-1919	Repairs to buildings and equipment.....	638 81	504 47	134 34
557-1919	Development and equipment water supply.....	4,484 86	4,431 89	52 97
		\$30,131 42	\$29,225 86	\$905 56
	<i>Fresno State Normal.</i>			
207-1915	Grounds.....	\$416 18	\$412 09	\$4 09
504-1911	Grounds.....	1,576 97	1,569 07	7 90
240-1917	Completion of plant and equipment.....	17 94		17 94
171-1913	Temporary buildings.....	101 12		101 12
393-1915	Clock system.....	113 05		113 05
516-1913	Building and equipment.....	36 41	36 41	
	Credit Controller's receipt, No. 1849.....	1,508 46		
303-1917	Claims of contractors.....	7,598 86		9,107 32
436-1919	Repairs, improvements and equipment.....	4,037 73	4,033 20	4 53
		\$15,406 72	\$6,050 77	\$9,355 95

**Financial Statement, Department of Engineering,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance June 30, 1920, and appropriations	Expended	1921 Balance July 29,
<i>Humboldt State Normal.</i>				
204-1915	Construction and equipment.....	\$4 42	-----	\$4 42
408-1919	Painting buildings.....	90 89	-----	90 89
743-1917	Construction, buildings, sidewalks, sewers and grading.....	126,747 66	\$123,077 80	3,669 86
237-1917	Painting temporary buildings.....	89	-----	89
742-1917	Equipment and furnishings.....	14,000 00	-----	14,000 00
		\$140,843 36	\$123,077 80	\$17,765 56
<i>Los Angeles State Normal.</i>				
Cont. 1006	Completion of roads and walks.....	\$0 57	-----	\$0 57
<i>Preston School of Industry.</i>				
400-1919	Repairs, improvements and equipment.....	\$43,122 66	\$23,440 75	\$19,681 91
156-1909	Cottage No. 2.....	581 95	581 95	-----
172-1913	Cottages.....	64 59	64 59	-----
529-1913	Hospital.....	679 67	678 57	1 10
549-1911	Concrete floor.....	702 43	700 63	1 80
301-1915	Repairs.....	239 21	239 21	-----
680-1911	Repairs.....	1 04	-----	1 04
411-1917	Repairs and improvements.....	73 62	73 33	29
522-1909	Pipe line.....	2 21	-----	3 21
531-1913	Addition to Trades Building.....	10,616 40	-----	10,616 40
195-1911	Water system.....	135 09	132 89	2 20
206-1911	Water power plant.....	6 33	6 00	33
		\$56,225 20	\$25,917 92	\$30,307 28
<i>San Diego State Normal.</i>				
246-1917	Improvements to grounds.....	\$9 19	\$6 76	\$2 43
236-1915	Grounds.....	01}	-----	65
	Controller's receipt, No. 1281.....	64}	-----	-----
491-1913	Improvements to grounds.....	10	-----	10
524-1911	Heating plant.....	1 77	1 53	19
308-1917	Paving.....	1,469 56	-----	1,469 56
333-1917	Repairs and improvements.....	29	-----	29
234-1915	Repairs and improvements.....	46	-----	46
490-1913	Repairs and improvements.....	11	-----	11
411-1919	Repairs and improvements, buildings and equipment.....	52 10	51 92	18
461-1919	Improvements to grounds and equipment.....	49 33	39 85	9 48
		\$1,583 56	\$100 11	\$1,483 45
<i>San Francisco State Normal.</i>				
491-1917	Buildings.....	\$450,000 00	-----	\$450,000 00
123-1911	Repairs.....	02	-----	02
225-1915	Remodeling buildings.....	25 90	-----	25 90
Cont. 18002	Repairs.....	1 57	-----	1 57
		\$450,027 49	-----	\$450,027 49
<i>San Jose State Normal.</i>				
219-1915	Outdoor classrooms.....	\$60 33	\$54 16	\$6 22
463-1913	Gymnasium and playgrounds.....	13 22	-----	13 22
426-1913	Repairs.....	185 54	185 43	11
258-1917	Assembly hall.....	1,528 32	1,523 74	4 58
193-1911	Grounds.....	138 43	137 39	1 04
391-1919	Improvements to heating plant.....	166 26	92 43	73 83
476-1919	Repairs, improvements and equipment.....	6,627 06	6,581 91	45 15
		\$8,719 21	\$8,575 06	\$144 15
<i>Santa Barbara State Normal.</i>				
451-1919	Repairs, improvements and equipment.....	\$18 11	-----	\$18 11
295-1915	Grounds.....	02	-----	02
257-1917	Gymnasium.....	13 21	-----	13 21
299-1915	Machinery building.....	21 64	-----	21 64
294-1915	Repairs.....	07	-----	07
546-1911	Main building.....	8 56	-----	8 56
547-1911	Lunch room.....	56	-----	56
250-1917	Sewer system.....	20 03	-----	20 03
		\$82 20	-----	\$82 20

**Financial Statement, Department of Engineering,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
<i>California School for Girls.</i>				
362-1917	Trades building and gymnasium	\$13 20	\$13 20	
	Credits	265 98)		
367-1917	Cottages	72 85)	126 20	\$212 63
365-1917	Heating system	17 29	3 08	14 21
	Credits	229 45)	148 84	98 51
366-1917	Improvements of grounds	17 90)		
361-1917	Ice plant	1 90		1 90
364-1917	Service connections	88 16	88 16	
474-1917	Water system	3 41	87	2 54
239-1915	Commissary building	2 34	2 34	
318-1915	Two cottages	4 75		4 75
241-1915	Cottages for males	3 53		3 53
262-1915	Drains	2 32		2 32
401-1913	Construction and equipment	39 20	39 20	
388-1919	Construction of cottages	86,474 28	30,513 17	55,961 11
389-1919	Farm buildings	49 70		49 70
569-1919	Improvements to grounds	90 93	81 47	9 46
584-1919	Completion of cottage unit	19,666 98	17,285 45	2,381 53
Support fund 6555-1920	Completion of work around building and grounds	1 77		1 77
Repairs, sup- port fund	Alterations to no privilege cottage	47		47
Support fund est. 2659	Alteration to hospital building	12 02	12 02	
Cont. 1229	Alteration on no privilege cottage	7 00	6 75	25
		\$107,065 43	\$48,320 75	\$58,744 68
<i>Whittier State School</i>				
590-1919	Repairs and improvements	\$3,151 13	\$2,706 58	\$444 55
629-1919	Construction of buildings	23,252 79	22,598 04	654 75
356-1917	Buildings	912 32	898 96	13 36
238-1915	Cottages	34 88	34 88	
355-1917	Power house	52 88	48 41	4 47
357-1917	Alterations and construction	47 50	46 23	1 27
Cont. 4837	Miscellaneous improvements	69,233 53	69,042 78	190 75
Cont. 1059	Construction refrigerator plant	446 36	446 36	
Cont. 3665	Drilling well	5,300 00	5,298 24	1 76
Est. sup. 4542	Hot water tank	18 42	14 37	4 05
		\$102,449 81	\$101,134 85	\$1,314 96
<b>HOMES.</b>				
<i>Berkeley School for Deaf and Blind.</i>				
293-1917	Completion heating plant	\$2,192 61	\$1 08	\$2,191 53
294-1917	Wiring	3 75		3 75
247-1915	Repairs	05		05
248-1915	Electric wiring	12 28		12 28
249-1915	Fire escapes	25 70		25 70
250-1915	Development of wells	413 06		413 06
251-1915	Repairs and improvements	6 31		6 31
277-1915	Heating system	121 97	19 05	102 32
442-1913	Dairy barn	17 53		17 53
440-1913	Gymnasium	231 14	43 22	187 62
514-1913	Repairs and improvements	1 99		1 99
655-1911	Industrial arts building	270 06		270 06
523-1911	Water supply	8 80	7 23	1 54
569-1909	Plumbing, etc.	2 64		2 64
Res. 81, 645-1915	Repairs to roofs	109 17	109 17	
		\$3,417 06	\$180 38	\$3,236 68
<i>California Industrial Farm for Women.</i>				
165-1919	Repairs to buildings, construction of dam	\$40,320 00	\$17,711 78	\$22,608 22



**Financial Statement, Department of Engineering,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
<i>Oakland Blind Home.</i>				
446-1919	Repairs .....	\$3 80		\$3 80
288-1917	Ground improvements .....	13 54		13 54
289-1917	Water supply .....	268 43	57 25	211 18
292-1917	Repairs .....	43		43
245-1915	Repairs .....	2 71		2 71
418-1913	Dormitory .....	270 33	170 20	100 13
419-1913	Floors in shop .....	102 68		102 68
Res. 51, 645-1919	Fuel burning equipment .....	1,050 00	271 30	778 70
		\$1,711 92	\$498 75	\$1,213 17
<i>Sonoma State Home.</i>				
624-1919	Cottage .....	\$751 39	\$748 33	\$3 06
380-1919	Sewers and drains .....	3,548 16	1,486 85	2,061 31
432-1919	Water supply .....	89,138 47	41,018 13	48,120 34
264-1917	Cottage .....	4 19		4 19
351-1917	Steam piping .....	52 58	39 52	13 06
352-1917	Reflooring .....	20 56		20 56
353-1917	Reconstructing Madrone Hall .....	2,458 29	2,327 15	131 14
208-1915	Barracks .....	1 28		1 28
297-1915	Water and steam piping .....	7 88	3 40	4 58
508-1913	Cottage .....	7 78		7 78
435-1913	Dormitory .....	10 04		10 04
509-1913	Farm buildings .....	156 55	148 36	8 19
436-1913	Nursery for males .....	133 23	50 50	82 73
434-1913	Septic tank .....	1 78		1 78
433-1913	Water supply .....	480 61	472 71	7 90
519-1911	Reflooring .....	5 35	5 35	
448-1909	Repairs Manor House .....	4 98	4 98	
568-1909	Power house boiler .....	28 26	14 38	13 88
Cont. est. 2630	Garage .....	56 74	56 74	
Cont. est. 7678	Switchboard .....	700 00	489 75	210 25
		\$97,568 22	\$46,866 15	\$50,702 07
<i>Veterans' Home.</i>				
442-1919	Repairs and improvements .....	\$19,791 90	\$19,364 02	\$427 88
483-1917	Boilers .....	12,467 59	7,405 12	5,062 47
426-1917	Kitchen and equipment .....	678 06	670 83	7 23
391-1917	Wiring .....	72 71	50 20	22 51
244-1917	Painting .....	196 80	193 74	3 06
392-1917	Plumbing .....	1 00		1 00
263-1917	Repairs .....	96 81	91 38	5 43
243-1917	Tubercular ward .....	5 39		5 39
216-1915	Electric wiring .....	1 90		1 90
215-1915	Plumbing .....	340 15	337 56	2 59
213-1915	Repairs .....	5 81	5 00	81
483-1913	Assembly Hall .....	95 57	76 87	18 70
484-1913	Dairy barn .....	21		21
409-1913	Lavatories .....	24 65	17 75	6 60
410-1913	Painting .....	6 33	5 70	63
470-1913	Pipe line .....	62 23	59 46	2 77
482-1913	Plumbing .....	48		48
411-1913	Repairs .....	1 19		1 19
235-1911	Cold storage .....	21 71	18 90	2 81
236-1911	Fire escapes .....	255 63		255 63
508-1911	Grounds, etc. .....	1 04		1 04
507-1911	Plumbing .....	1 38		1 38
521-1911	Septic tanks .....	834 68	831 62	3 06
252-1909	Distilling water .....	4 85		4 85
488-1909	Store house .....	1 82		1 82
645-1919	Repairs to kitchen .....	2,000 00	210 75	1,789 25
		\$36,969 89	\$29,338 90	\$7,630 99

**Financial Statement, Department of Engineering,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
<b>HOSPITALS.</b>				
<i>Agnews State Hospital.</i>				
568-1919	Cottages .....	\$20,817 89	\$16,405 26	\$4,412 63
402-1919	Heating plant .....	949 14	458 11	491 03
207-1917	Cottage .....	3 01	-----	3 01
332-1917	Workers' cottage .....	15 78	-----	15 78
754-1915	Cottage .....	49 337	-----	-----
	Credit Controller's receipt, No. 391 .....	278 57	-----	327 90
400-1913	Cottage .....	5,108 56	38 00	5,070 56
473-1913	Nurses' home .....	1,912 27	-----	1,912 27
		\$29,134 55	\$16,901 37	\$12,233 18
<i>Mendocino State Hospital.</i>				
404-1919	Sundry improvements .....	\$3,404 00	\$3,378 26	\$25 74
443-1919	Heating system .....	66 24	58 27	7 97
444-1919	Shelters for women patients .....	978 73	953 27	25 46
267-1917	Water softening .....	22 11	20 00	2 11
268-1917	Reconstruction Ward No. 7 .....	118 83	117 26	1 57
225-1917	Plumbing repairs .....	178 00	170 86	7 14
526-1917	Operating room .....	648 00	614 63	33 37
327-1917	Reconstruction Ward No. 10 .....	5 33	1 91	3 42
370-1917	Boilers, etc. .....	108 79	108 66	13
371-1917	Repairs Administration Building .....	68 85	55 40	13 45
192-1915	Pipe line .....	144 86	142 60	2 26
305-1915	Plumbing repairs .....	32 36	31 32	1 04
107-1913	Dam and reservoir .....	3,042 91	28 23	3,014 68
481-1913	Gas plant .....	3 00	3 65	25
Cont. est. #2953	Fences, shelters .....	1,322 59	1,322 59	-----
Cont. est. #3245	Tank tower .....	8 25	8 25	-----
Cont. est. #5640	Water supply .....	116 00	116 00	-----
Cont. est. #1058	Substation transmission lines, etc. ....	2,175 21	-----	2,175 21
		\$12,444 96	\$7,131 16	\$5,313 80
<i>Napa State Hospital.</i>				
565-1919	Quarters for employees .....	\$50,000 00	\$48,055 03	\$1,944 97
397-1919	Heating system .....	1,352 85	6 05	1,346 80
242-1917	Pathological laboratory .....	19,095 79	-----	19,095 79
308-1917	Electric elevators .....	35 70	-----	35 70
397-1917	Power house .....	1 18	-----	1 18
399-1917	Sewers .....	7 66	-----	7 66
410-1917	Reclamation and Irrigation, low lands ..	18 01	17 32	69
241-1917	Cottages .....	3 24	2 31	93
480-1917	Cottages .....	65 71	59 52	6 19
789-1917	Water supply .....	324 85	44 50	280 35
352-1915	Power house .....	59	-----	59
324-1915	Cottage .....	9 34	-----	9 34
487-1913	Dairy building .....	441 51	-----	441 51
486-1913	Dormitories .....	1,000 00	-----	-----
	Credit .....	146 87	862 75	284 12
408-1913	Heating system .....	86 65	2 00	84 65
405-1913	Laundry .....	252 01	252 01	-----
404-1913	North pay cottage .....	46 95	46 95	-----
488-1913	Rewiring .....	51	-----	51
489-1913	Reclamation, low lands .....	76	-----	76
506-1911	Cold storage .....	49 99	-----	49 99
505-1911	Irrigation .....	4 54	4 54	-----
489-1909	Cottage .....	319 48	319 48	-----
314-1909	Kitchen .....	51 99	51 99	-----
315-1909	Receiving building .....	34 83	-----	34 83
Cont. est. #2838	Power line .....	814 44	814 44	-----
Cont. est. #176	Rewiring superintendent's residence ..	370 00	340 16	29 84
Cont. est. #8371	Boring well .....	2,500 00	2,500 00	-----
		\$77,035 45	\$53,379 05	\$23,656 40

**Financial Statement, Department of Engineering,  
Division of Architecture—Continued.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
<i>Norwalk State Hospital.</i>				
588-1919	Officers' quarters and dining room.....	\$42,960 00	\$42,943 79	\$16 21
587-1919	Cottage.....	148,977 71	100,367 75	48,009 96
586-1919	Improvements on farm.....	1,993 72	1,940 45	53 27
585-1919	Water tower, etc.....	19,908 93	16,195 25	3,713 68
343-1917	Superintendent's cottage.....	15 18	9 65	5 53
344-1917	Farm buildings.....	3,950 00	3,924 72	25 28
433-1919	Completion buildings.....	5,691 98	5,623 00	68 98
345-1917	Construction administration building.....	43,033 73	13,230 45	29,803 28
346-1917	Three cottages.....	51 10	51 10	-----
455-1913	Buildings, etc.....	9 96	9 96	-----
237-1915	Buildings, etc.....	34 35	34 35	-----
Cont. est. 10512	Completion superintendent's residence.....	32 34	32 34	-----
<i>Southern California State Hospital.</i>				
440-1919	Heating plant.....	\$1,554 58	\$314 95	\$1,239 63
336-1917	Boilers.....	9 39	-----	9 39
338-1917	Cottages.....	4 13	-----	4 13
339-1917	Pump and motor.....	20 45	11 60	9 85
404-1917	Nurses' home.....	147 47	-----	147 47
477-1913	Four cottages.....	771 85	-----	771 85
461-1909	Physician's cottage.....	2 16	-----	2 16
462-1909	Dining hall.....	244 27	-----	244 27
457-1909	Female cottage No. 2.....	17 00	-----	17 00
459-1909	Female cottage No. 3.....	50 90	-----	50 90
155-1907	Dairy barn.....	135 10	-----	135 10
496-1913	Laundry.....	8 51	-----	8 51
466-1909	Cottage.....	65 64	-----	65 64
281-1911	Power plant.....	107 70	-----	107 70
497-1913	Reservoir.....	208 88	-----	208 88
453-1909	Storm drains.....	274 71	123 93	150 78
Cont. est. #6186	Roofing buildings.....	46 20	-----	46 20
Cont. est. #217	Deep well, pump and motor.....	6,875 00	5,999 61	875 39
		\$10,543 94	\$3 450 09	\$4,093 85
<i>Stockton State Hospital.</i>				
606-1919	Cottage.....	\$47,704 10	\$47,699 16	\$4 94
437-1919	Heating plant.....	2,537 94	2 537 94	-----
394-1919	Completion tubercular hospital.....	343 16	343 16	-----
398-1919	Sewer system.....	14,897 37	642 89	14,254 48
399-1919	Repairs.....	396 91	396 91	-----
272-1917	Tubercular hospital.....	5 19	-----	5 19
330-1917	Cottage.....	211 84	205 48	6 36
414-1913	Elevators.....	86 09	-----	86 09
127-1911	Fire system.....	11 74	-----	11 74
197-1911	Heating system.....	2 78	-----	2 78
172-1907	Receiving ward.....	18 84	-----	18 84
126-1911	Sewing room.....	2 26	-----	2 26
416-1913	Ward No. 25.....	269 14	114 67	154 47
211-1915	Boilers.....	187 10	-----	187 10
210-1915	Convalescent building.....	17 13	17 13	-----
310-1915	Cottage for males.....	17 63	16 38	1 25
300-1915	Farm buildings.....	6 58	-----	6 58
234-1917	Repairs and additions.....	1 67	-----	1 67
Cont. est. #1587	Tank tower, painting.....	96 10	96 10	-----
Cont. est. #2379	Repairs water tank.....	13 90	13 90	-----
Cont. est. #9535	Main sewer.....	418 07	418 07	-----
Cont. est. #331	Steam and water supply systems.....	2 17	2 17	-----
		\$67,252 81	\$52,508 96	\$14,743 85
<i>Pacific Colony.</i>				
562-1919	Buildings.....	\$63,992 31	\$62,622 84	\$1,369 47



**Financial Statement, Department of Engineering,  
Division of Architecture—Concluded.**

Chapter and year	Name of job	Balance June 30, 1920, and appro- priations	Expended	Balance July 29, 1921
<b>PRISONS.</b>				
<i>Folsom State Prison.</i>				
422-1919	Machine and blacksmith shop -----	\$1,500 00	\$220 95	\$1,279 05
396-1919	Electrical equipment -----	4,000 00	3,240 49	759 51
467-1919	Repairs -----	6,752 10	6,567 56	184 54
276-1917	School building -----	1,122 63	604 88	517 75
278-1917	Repairs -----	31 07	24 75	6 29
449-1913	Cells and walls -----	182 36	182 28	08
313-1915	Bake oven -----	44 81	44 75	06
254-1917	Sewage disposal -----	3 48	3 48	-----
273-1915	Cells, etc. -----	481 47	240 61	240 86
		\$14,117 92	\$11,129 78	\$2,988 14
<i>San Quentin State Prison.</i>				
401-1919	Electrical installation -----	\$2,391 76	\$1,840 18	\$551 58
233-1917	Rewiring -----	1,026 68	1,002 04	24 64
253-1917	Rewiring -----	65 33	63 34	1 99
284-1917	Small building -----	37 29	25 32	11 97
285-1917	Additional farm buildings -----	5,000 00	-----	5,000 00
559-1909	Guards cottages -----	83 32	-----	83 32
228-1915	Water supply -----	4,111 83	-----	4,111 83
562-1911	Cells and walls -----	4 65	4 50	15
		\$12,720 86	\$2,935 38	\$9,785 48
<b>MISCELLANEOUS.</b>				
475-1917	State nursery at Davis -----	\$10,000 00	\$8,186 84	\$1,813 16
645-1919	Repairs trusses Capitol building -----	1,956 91	1,040 74	916 17
645-1919	Alteration to rooms, Capitol building -----	196 22	169 00	27 22
368-1917	Painting, Capitol building -----	28 85	-----	28 85
762-1917	State printing office -----	100,000 00	-----	100,000 00
532-1913	State Capitol conservatory -----	45 73	-----	45 73
538-1913	State Capitol elevators -----	34 85	-----	34 85
430-1917	Secretary of State office vault -----	687 30	-----	687 30
618-1919	San Francisco State building -----	350,000 00	-----	350,000 00
Fund	San Francisco State building -----	813,350 40	177,004 25	636,346 15
Fund	Sacramento State buildings -----	6,550 48	2,012 63	4,537 85
619-1919	Sacramento State buildings -----	300,000 00	-----	300,000 00
400-1917	Marshall monument -----	3 92	-----	3 92
321-1917	Monterey Customs House -----	186 85	-----	186 85
311-1917	Fort Ross repairs -----	1,053 28	-----	1,053 28
679-1915	Fort Ross repairs -----	24 61	-----	24 61
322-1911	Mission San Francisco De Solano Sonoma -----	109 84	81 56	28 28
480-1913	Mission San Francisco De Solano Sonoma -----	894 61	799 58	95 03
693-1915	Mission San Francisco De Solano Sonoma -----	102 12	-----	102 12
Fund	Fish and Game Commission office build- ing, San Pedro -----	29,000 00	2,357 55	26,642 45
Fund	Fish and Game Commission office, Lake Tahoe Hatchery -----	17,310 00	17,245 51	64 49
		\$3,301,416 39	\$1,060,437 05	\$2,240,979 34

















